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FM 4-29

WAR DEPARTMENT FIELD MANUAL

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SERVICE OF SEACOAST SEARCHLIGHT

DISSEMINATION OF RESTRICTED MATTER.
No person is entitled solely by virtue of his grade or position to knowledge or possession of classified matter. Such matter is entrusted only to those individuals whose official duties require such knowledge or possession. (See also paragraph 23b, AR 380-5, 15 March 1944.).

WAR DEPARTMENT • 30 AUGUST 1945

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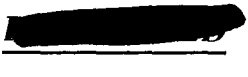


CHAPTER 1

GENERAL

1. SCOPE. This manual is a guide for the battery commanders, platoon commanders, section leaders, and light commanders of seacoast artillery searchlight units in harbor defenses or in the field in training searchlight squads in the orderly, efficient operation of seacoast searchlights. It covers organization and equipment, searchlight employment, duties of personnel, service of the searchlight, field operations, care and adjustment of materiel, and destruction of equipment.

2. REFERENCES. This manual is intended for use in conjunction with existing field and technical manuals on searchlights and associated subjects. Appropriate manuals are listed in appendix I.

3. DEFINITIONS. The following is a brief glossary of terms used in searchlight operation:[1]

Barrier light. A searchlight used to place an unmoving beam across a channel or a harbor entrance.

Control station. Element of searchlight equipment used to move the searchlight in azimuth and elevation by distant electric control.

Designation. Each searchlight is designated for command purposes by the number of the position it occupies. For example, the command TWO, COVER FOUR orders the searchlight designated as No. 2 to cover

[1] For definitions of military terms not contained in this manual, see TM 20–205, and for a complete list of available training publications, see FM 21–6.

the target illumi[redacted]chlight designated as No. 4.

Detector. A radar set (SCR–268 or AN/TPL–1) used for searchlight control. This set is not usually available to seacoast artillery searchlight units.

Distant electric control (DEC). Control of the searchlight from a flank station located not more than 500 feet from the searchlight.

Extended hand controller. Device used to operate the searchlight manually (used in the event of failure of distant electric control).

Illuminating light. A searchlight used to illuminate hostile vessels so that they may be tracked and fired on.

Normal beam. The 1¼° beam projected by a properly adjusted searchlight when spread-beam equipment is not used.

Searching light. A searchlight used to search water areas for the purpose of detecting hostile vessels.

Searchlight set. This term is used to designate one searchlight and the associated equipment required to operate it (control station, power plant, etc.).

Spread beam. The 10° beam obtainable by the use of spread-beam lenses.

STAND BY. The command at which the designated light is kept ready to go into action immediately. If the position of the target is known, the light is kept trained on it.

4. COMMANDS. Commands used in searchlight operation and control are listed in FM 4–5.

CHAPTER 2

ORGANIZATION AND EQUIPMENT

Section I. ORGANIZATION

5. GENERAL. Each seacoast searchlight is operated by a squad comprising a light commander, a control station operator, a power plant operator, and a searchlight operator. Larger searchlight units consist of a number of squads augmented by necessary administrative and repair personnel, organized into sections, platoons, and, in the case of T/O&E 4–68, into a battery. In mobile organizations, the searchlight squad also includes truck drivers and machine gunners.

6. HARBOR DEFENSE SEARCHLIGHTS. Seacoast searchlights in a harbor defense are operated by the seacoast platoon of the searchlight battery (T/O&E 4–68). This platoon comprises four to twelve searchlight squads grouped in two, three, or four sections. Each section operates two or three searchlights. Each platoon includes communications personnel and a searchlight electrician.

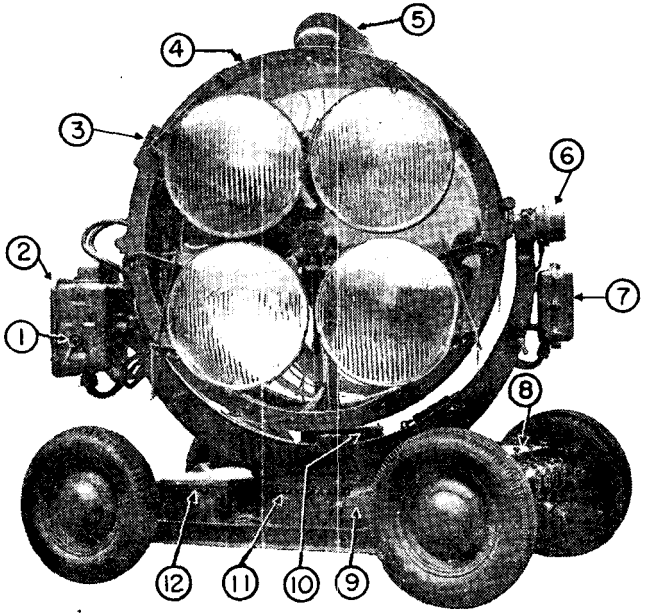
7. SEARCHLIGHTS FOR ANTIMOTOR TORPEDO BOAT DEFENSE. Each 90-mm AMTB battery (T/O&E 4–77) is assigned one searchlight and personnel comprising one searchlight squad to man it.

8. SEARCHLIGHTS WITH MOBILE ARTILLERY. A searchlight platoon is included in the headquarters battery of each 155-mm gun battalion (T/O&E 4–156). This platoon consists of a platoon headquarters and two sections of four searchlight squads each and in-

cludes a searchlight electrician, truck drivers, and machine gunners.

Section II. EQUIPMENT

9. GENERAL. **a.** The searchlight sets authorized for issue to seacoast artillery units include the 60-inch mobile searchlight, the distant electric control station, the extended hand controller, the power

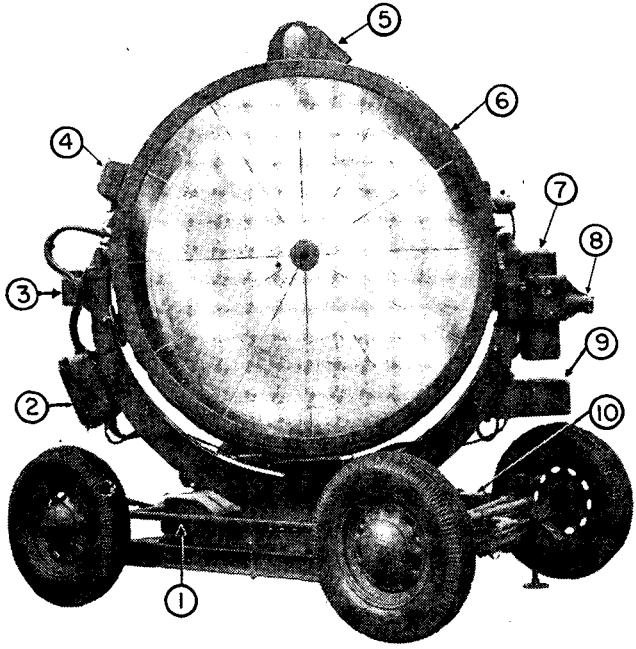


1. Arc switch handle.
2. Elevation control box.
3. Lamp mechanism box.
4. Drum.
5. Ventilating fan housing.
6. Elevation control transformer.
7. Elevation amplifier box.
8. Junction box.
9. Azimuth amplidyne motor-generator.
10. Elevation amplidyne motor-generator.
11. Azimuth circle.
12. Azimuth control box.

Figure 1. General Electric searchlight M1942 (with spread-beam lenses).

plant, and interconnecting cables. Transportation is authorized separately on T/O&E.

b. Searchlight equipment now in service includes components of two types and several models. The types are General Electric and Sperry, the names of the manufacturers producing the equipment. Each manufacturer produced a new model each year between 1939 and 1942, designated by the number of the year (M1940, M1941, etc.), and each manufacturer

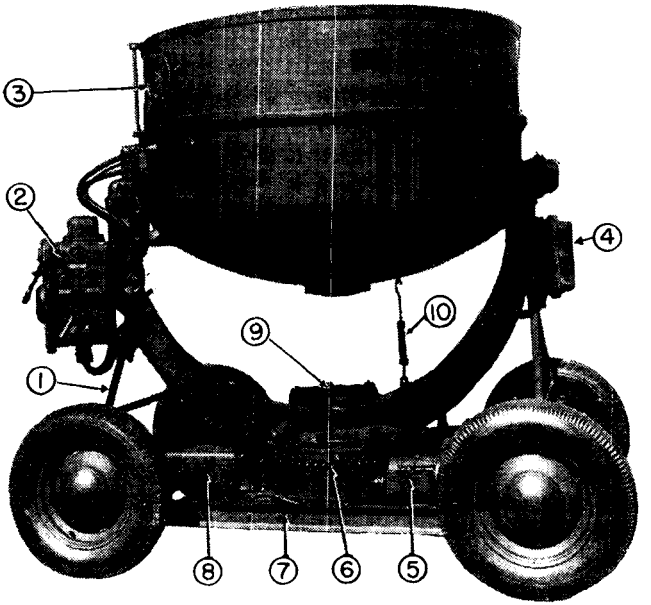


1. Azimuth drive housing.
2. Arc switch box.
3. Meter box.
4. Lamp operating mechanism box.
5. Blower hood.
6. Drum.
7. Elevation drive housing.
8. Extended hand controller socket.
9. Elevation amplifier housing.
10. Azimuth motor-amplidyne generator.

Figure 2. Sperry searchlight M1942 (operating position).

also produced two special models (M1941A and M1942A). Some earlier Sperry models, dating as early as 1934, may still be in service. All of these items of equipment were originally designed for anti-aircraft use but all of them can readily be used for seacoast artillery missions.

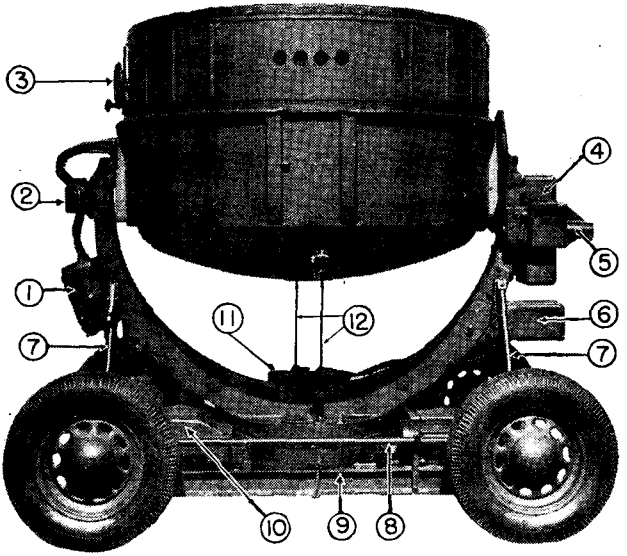
c. When issued, searchlight sets usually consist of elements of the same type and model. However, with the exception of searchlights M1942 and M1942A, equipments made by the same manufacturer in different years differ so little as to be widely inter-



1. A-frame.
2. Elevation control box.
3. Beam-spread handwheel.
4. Elevation amplifier box.
5. Azimuth amplidyne generator.
6. Azimuth scale.
7. Chassis.
8. Azimuth control box.
9. Elevation amplidyne generator.
10. Elevation stowing spring.

Figure 3. General Electric searchlight M1942 (transportation position).

changeable. Control stations, extended hand controllers, and control cables of Sperry searchlights M1939, M1940, M1941, and M1941A may be used in any combination to operate any Sperry searchlight of any of those models. Control stations, extended hand controllers, and control cables of General Electric searchlights M1940, M1941, and M1941A may be used in any combination to operate any General Electric searchlight of any of those models. General Electric and Sperry power equipment (power plants



1. Arc switch box.
2. Meter box.
3. Beam-spread handwheel.
4. Elevation drive housing.
5. Extended hand controller socket.
6. Elevation amplifier housing.
7. A-frames.
8. Steering bar.
9. Chassis.
10. Azimuth drive housing.
11. Elevation amplidyne generator.
12. Elevation transportation lock bars.

Figure 4. Sperry searchlight M1942 (transportation position).

and power cables) for 60-inch searchlights can be used interchangeably with either type of searchlight of any model since 1936. Because of a modification in azimuth and elevation drive equipment, 1942 models of either type cannot be used with control equipment of earlier models, but all components of General Electric and Sperry 1942 equipment are interchangeable except for the extended hand controllers.

d. This manual includes summarized descriptive data on the 1942 models of both types (figs. 1 to 4). For more complete information, appropriate technical manuals should be consulted. (See references, app. I.)

10. SEARCHLIGHTS. a. Components. The searchlight consists of the chassis, the base, the turntable (mounting the trunnion arms), and the drum. Each of these components is discussed briefly below.

(1) *Chassis.* The chassis, carried on four rubber-tired wheels, is primarily a frame for mounting the searchlight. Four jacks, one at each corner of the frame, support the equipment during operation and provide a means for leveling the chassis. A towing bar is provided for use when it is necessary to move the searchlight by hand. (The searchlight should not be towed by truck except when mounted in the searchlight trailer.) The following electrical and mechanical elements of the equipment are mounted on the chassis: the dynamotor, which converts a portion of the d.c. supply into power for the a.c. elements of the equipment; the junction box, which contains receptacles for interconnecting cables (par. 14); a ballast resistor, which compensates for varying lengths of power cable; and elements of the azimuth control system (varying in detail with different searchlight models).

(2) *Base.* The base assembly has two functions: to support the turntable and to transfer arc and control voltages to other elements of the searchlight during operation. A central pivot and heavy-duty

annular ball bearings support the turntable. A slip-ring subassembly transmits the required voltages from the junction box to brushes mounted on the turntable. An azimuth scale encircles the base. (As issued, searchlight azimuth circles are graduated in mils. Circles graduated in degrees have been distributed to some harbor defenses. Similar scales for all seacoast searchlights now in service will be issued.) Some elements of the azimuth control and drive systems are mounted on the base (varying in detail with different searchlight models).

(3) *Turntable* (*trunnion arms*). The turntable supports the drum at the trunnions and contains gearing which meshes with other gears on the base and the drum to drive the searchlight in azimuth and elevation. All elevation control and drive mechanisms are mounted on the trunnion arms assembly. The arc voltmeter, the arc ammeter, and the zero reading meters are also mounted on the trunnion arms.

(4) *Drum.* The drum is a large cylinder of aluminum alloy (or sheet steel, in some later models), consisting of front and rear sections joined to form a unit. It houses the lamp and the mirror. The lamp consists of a high-intensity carbon arc and the necessary electrical and mechanical connections to maintain a high current flow through the carbons and to keep the gap separating them at a constant value. The composition of the carbons is such that the passage of a high current through them and across the arc causes a small, brightly burning globule of incandescent gas to form at the tip of the positive carbon. This luminous ball of vapor is the light source for the searchlight. The 60-inch parabolic mirror focuses light rays from the arc into a narrow (1¼°) beam having an intensity of 800,000,000 candlepower. A ventilating fan, mounted on top of the drum, cools the lamp elements and exhaust vapors given off by the arc, preventing discoloration of the mirror or the glass drum doors. Other control elements mounted

on the outside of the drum include: the lamp control mechanism, which controls operation of the arc (par. 31); the peep sights and ground-glass finder used to view the arc during operation; the elevation rack, which engages the elevation drive gearing on the right trunnion arm; and a peep sight, used in orientation (mounted on the left side of the drum). The recarboning lamp, mounted inside the drum, provides light when it is necessary to change carbons during operation. An elevation scale is mounted on the elevation rack.

b. Spread-beam modification. (1) The normal (1¼°) beam of the searchlight is unsatisfactory for tracking maneuverable, high-speed targets (such as

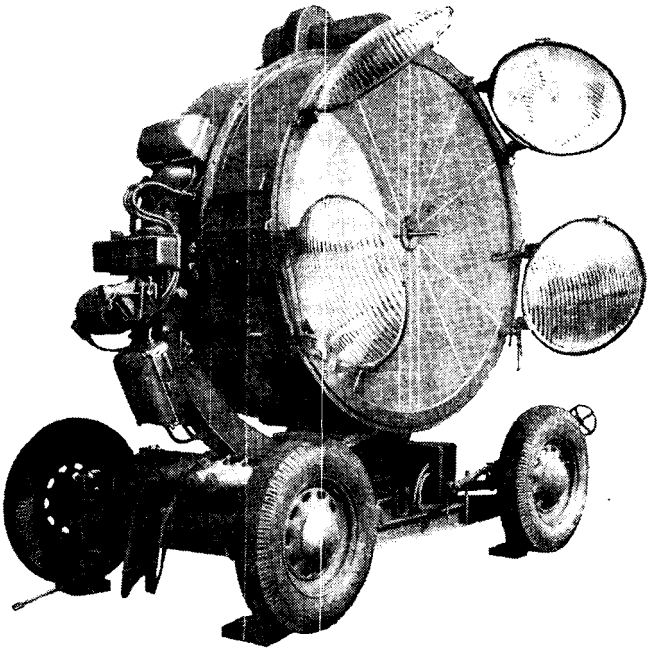


Figure 5. Searchlight with spread-beam lenses (normal-beam position).

motor torpedo boats) at short ranges. Most mobile searchlights now in service have been modified to permit spreading the beam to a width of 15° by defocusing the light. (See FM 44–6 and FM 44–75.) However, this modification is not considered suitable for seacoast searchlights, and a special modification has been authorized for use by seacoast artillery units.

(2) The seacoast artillery spread-beam equipment consists of four lenses mounted in front of the glass door of the drum (figs. 5 and 6). When these lenses are locked in the open position (fig. 5), the searchlight projects the normal beam. When the lenses are

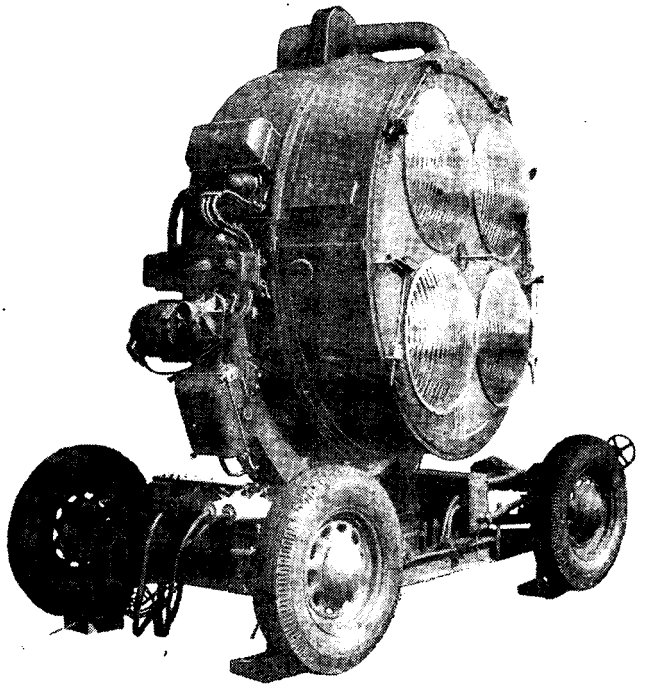


Figure 6. Searchlight with spread-beam lenses (spread-beam position).

closed (fig. 6), the beam is spread to 10° in the horizontal dimension but the vertical dimension of the beam is virtually unchanged. (The convolutions of the lens must be vertical to achieve this effect.)

(3) The spread-beam modification kit for use with Sperry searchlights later than model 1934 and General Electric searchlights later than model 1940 may be obtained by requisition through channels to the Chief of Engineers. The kit includes the following: six 24-inch molded glass lenses (four for use, two for spares), five of them complete with lens-holding rings; hinge-type mounting brackets; a counterweight assembly (used to adjust the balance of the drum after installation of the lenses); and necessary installation hardware. Instructions for installing the modification on any standard light accompany each kit. (*Note.* In addition to the adjustments described in the installation manual, the counterweight assembly should also be adjusted to compensate for the condition in which two of the lenses are open and the other two are closed.)

11. CONTROL STATIONS. It is difficult for an observer stationed at or near the searchlight to track a target illuminated by the beam. In order to do so, he must observe the target through the searchlight beam. The range at which he is effectively able to do so is considerably reduced by the effect of illuminated particles in his line of sight. The farther the observer can be displaced from the light (consistent with technical considerations of control), the better are the results which can be obtained. The distant electric control station is a solution to this problem. Equipment now in use permits visual tracking of an illuminated target from a station 300 to 500 feet distant from the searchlight. Angular movement of the control station handwheels is transmitted electrically to the searchlight and transformed into mechanical energy causing a corresponding angular movement of the searchlight. When the two elements

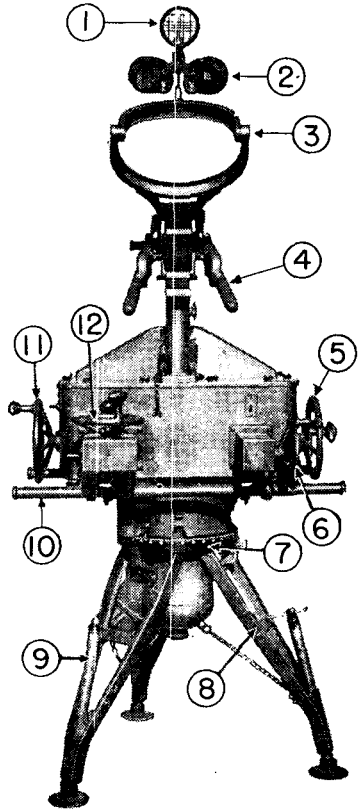
are properly oriented and synchronized, the searchlight automatically follows a target held in the field of the observer's binocular at the control station.

a. Components. The three principal components of the control station are the tripod, the control unit, and the binocular mount. Each is described briefly below.

(1) *Tripod.* The main function of the tripod is to provide support for the other components of the control station. Tripod equipment includes jackscrews for leveling the station. Sperry tripods include a receptacle for the control cable, and slip rings, brushes, and contacts for the transmission of electrical energy from the fixed base to the rotating control unit. The General Electric tripod contains no electrical equipment.

(2) *Control unit (controller).* Four handwheels and two zero-reading meters are the outstanding features of the control unit. Of these, only the two observer's handwheels (fig. 7) are used in normal seacoast operation. The other handwheels and the zero-reading meters are used only when a radar detector is a part of the searchlight system (except as noted in par. 33). Movement of the observer's azimuth handwheel rotates the control unit (a selector permits choice of two speeds of control unit rotation) and generates a control voltage which is transmitted to the searchlight. Movement of the observer's elevation handwheel moves the binocular mount in elevation and generates a control voltage which is transmitted to the searchlight. The unit is equipped with slip clutches which permit slewing of the control unit in azimuth independently of the searchlight. The General Electric controller is set on a fixed base which contains a receptacle for connecting the control cable and contacts through which power is transmitted to the searchlight.

(3) *Binocular mount.* The binocular mount supports the observer's binocular (or open sight) at a height which can be adjusted to conform to the



1. Daylight sight.
2. Binocular.
3. Elevation linkage.
4. Binocular mount adjustment handles.
5. Elevation zero reader handwheel.
6. Observer's elevation handwheel.
7. Azimuth circle.
8. Tripod leg.
9. Leveling jack.
10. Carrying handle.
11. Azimuth zero reader handwheel.
12. Observer's azimuth handwheel.

Figure 7. Control station.

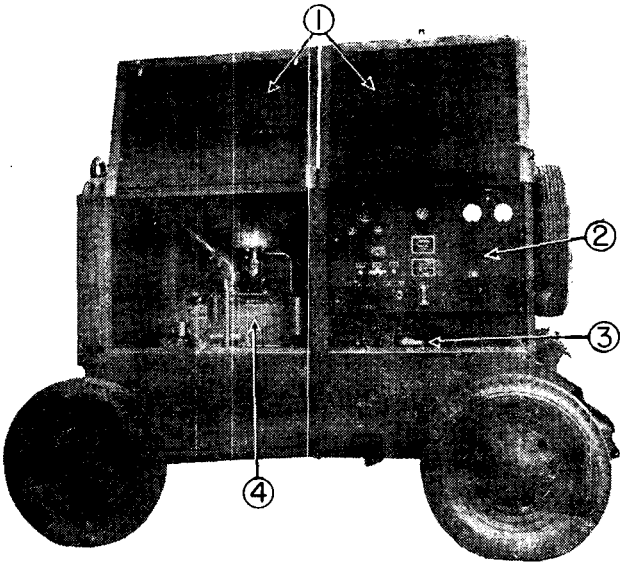
height of the observer. A system of gearing and linkage permits movement in elevation corresponding to the movement of the searchlight. Slip clutches and control handles permit slewing of the binocular independently of the control unit and the searchlight. This adjustment compensates for any error which may be introduced by parallax between the control station and the searchlight. This component is not essential for seacoast searchlight operation.

b. Modifications. Control stations as issued have no azimuth scales. Azimuth circles graduated in degrees are issued separately for control stations used by Coast Artillery units (fig. 7). Pending receipt of these scales, azimuth circles must be improvised.

12. EXTENDED HAND CONTROLLER. The extended hand controller is a device for driving the searchlight manually in elevation and azimuth in the event that the distant electric control system fails. It consists of an outer sleeve, approximately 10 feet long, and a concentric shaft terminating in a handwheel. The sleeve is inserted in a socket on one of the trunnion arms (the left trunnion arm of the Sperry M1942 searchlight; the right trunnion arm on the General Electric 1942 model) and clamped into place. A key on the concentric shaft engages the elevation gearing on the searchlight so that the searchlight can be moved in elevation by rotation of the handwheel on the extended hand controller. The sleeve is used as a lever to move the searchlight in azimuth. (Azimuth and elevation clutches must be manipulated to disengage power drive gearing before hand control may be used.) This system permits emergency pointing of the searchlight and provides sufficient displacement for the observer to reduce slightly the undesirable effects of observation through the searchlight beam.

13. POWER PLANT. The searchlight power plant (fig. 8) is a gasoline-engine-driven generator with a

rated output of approximately 160 amperes (d.c.) at 100 volts. The control panel includes motor meters and controls similar to those on an automobile dashboard; a main power switch; a power ammeter; a power voltmeter; and a field rheostat used to control output current and voltage. Power plants of different models vary considerably in detail but are sufficiently alike in performance to be used interchangeably with any model since 1936 of either type of searchlight.



1. Side access doors.
2. Control panel.
3. Generator.
4. Engine.

Figure 8. Power plant.

14. INTERCONNECTING CABLES. Three cables are required to connect elements of the searchlight system. These are two power cables, one positive and one negative, each 200 feet long, and a control cable 300 or 500 feet long (depending on the equipment model being used). The power cables are

connected between the main power receptacles at the power plant and the yellow-painted receptacles on the junction box at the searchlight. The 15-conductor control cable is connected from the receptacle on the tripod of the control station to the red-painted receptacle on the junction box at the searchlight. The blue receptacles on the searchlight junction box (there may be one or two, depending on the model) are not used in normal seacoast searchlight operation. Later model searchlights have no color coding of receptacles, but construction of the plugs prevents wrong connections.

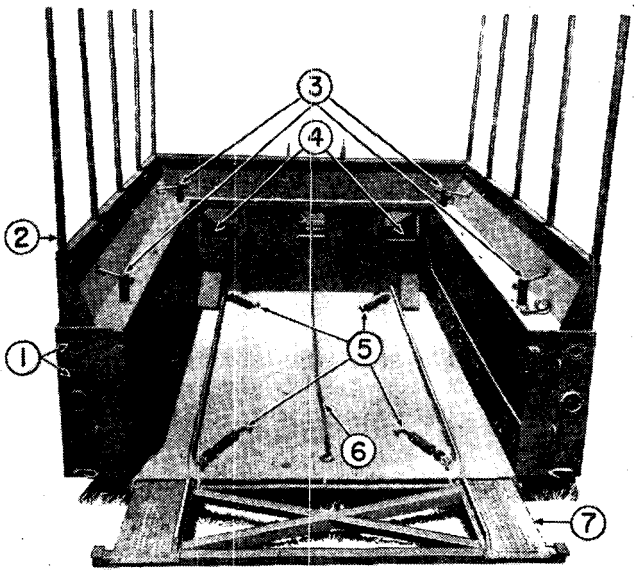
15. TRANSPORTATION. A completely mobile searchlight unit (AA) is equipped with two 2½-ton cargo trucks and a searchlight trailer M1. Headquarters battery of the 155-mm gun battalion, which is designated as semimobile, is authorized one 2½-ton truck and one searchlight trailer for each two searchlights. Each harbor defense is authorized one searchlight trailer for such movement of searchlights as may be necessary.

a. The searchlight trailer M1 (figs. 9 and 10) is a four-wheel, pneumatic-tired tilting trailer with a load capacity of 4,000 pounds. It is equipped with a hand-operated winch used for loading the searchlight and with four turnbuckles which engage hold-down devices on the searchlight chassis to lock it in place during transportation. Access doors in the front of the trailer permit reaching the front turnbuckles. It has hand brakes, used when the trailer is parked, and four-wheel electric brakes which can be operated from the cab of the towing truck. A jumper cable provides power for the brakes and for tail and stop lights on the trailer. A breakaway chain sets the brakes in the event that the trailer breaks loose from the towing truck.

b. The power plant is transported over smooth roads by towing behind a 2½-ton truck. Over bad roads, it is advisable to load the power plant in a

searchlight trailer or a 2½-ton truck if it is to be transported for a long distance. If the power plant is loaded in a vehicle, it must be securely chocked and wired in place.

16. SPARE PARTS. A complete list of organizational spare parts for 1942 searchlights is contained in Army Service Forces catalogs ENG 7–S53 (Sperry) and ENG 7–S55 (General Electric). These catalogs also serve as authority for the requisition of replacement parts.



1. Blackout, stop, and taillight.
2. Removable bows.
3. Corner jacks.
4. Access doors.
5. Turnbuckles.
6. Winch chain.
7. Tailgate (ramp for loading).

Figure 9. Searchlight trailer M1, tilted for loading.

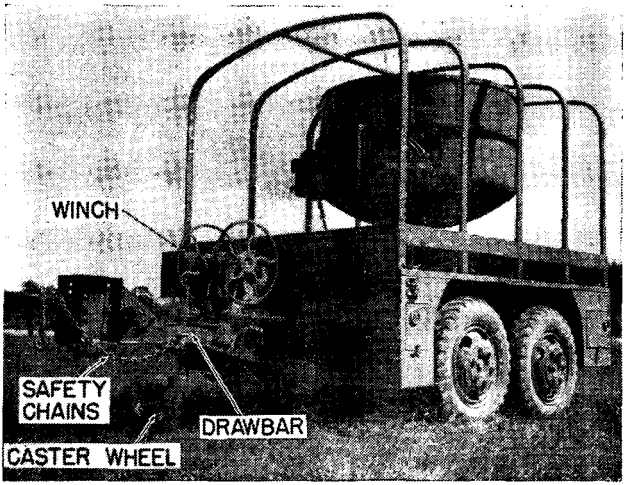


Figure 10. Searchlight trailer M1, loaded (cover removed).

CHAPTER 3

EMPLOYMENT OF SEACOAST SEARCHLIGHTS

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17. SEACOAST ARTILLERY ROLE. a. Missions. Seacoast artillery searchlights are employed primarily as a surveillance aid for Coast Artillery batteries and associated beach defense detachments. Searchlights employed in this way are used to—

(1) Search water areas (searching lights).

(2) Illuminate hostile naval vessels (illuminating lights).

(3) Place a barrier beam across a channel or other confined approach to a defended area (barrier lights). These lights are used only in exceptional cases (FM 4–5).

(4) Illuminate or search beaches.

b. Communications. A telephone net suitable for use by both harbor defense units and mobile organizations is shown in figure 11. (This installation may be modified to place the searchlight officer and the searchlight switchboard in the radar station in situations where this is practicable. However, it is of first importance for the searchlight officer to have an uninterrupted view of the water area covered by searchlights under his control.) The circuit from the searchlight switchboard to the telephones at searchlight and controller should be operated as a "hot loop," that is, one or both of the telephones should be manned at all times except when the command REST has been given. When the searchlight squad is at rest, one or more members of the squad should be near enough to the telephone at all times to hear the ringing signal. When the tactical situation requires that control of any searchlight or search-

lights be turned over to the commander of a firing battery, the battery CP and the searchlight or searchlights should be connected through the searchlight switchboard as indicated. This net may be readily modified in situations requiring additional lines (as in the case of a 155-mm battalion operating as four two-gun firing units). The searchlight officer's telephone may be eliminated (in this case the officer relays his commands to the searchlight squads through the telephone operator). The trunks between command post switchboard and searchlight switchboard may be eliminated if the two switchboards are close enough together to permit direct oral relay of intelligence between the two switchboards. Two or more searchlights may be connected on a single line (in this case, searchlights sited to illuminate the field of fire of a particular battery or firing unit should be connected on the same line to facilitate searchlight control by the battery commander). If necessary, the battery searchlight control line may be connected through the command post switchboard (in this case, trunks connecting the command post switchboard and the searchlight switchboard will be necessary).

c. Assignment and pickup of targets. When the searchlight officer desires to illuminate a target located by surveillance radar or other means, he telephones a relocated azimuth (allowing for travel during 20 seconds of dead time) to the searchlight or searchlights best able to illuminate the area. If the target is not illuminated when the searchlight is turned on and is not detected in the 10° sector of search (par. 33*b*), the searchlight officer gives the orders necessary to place the searchlight beam on target. He commands: RAISE (LOWER) if it is evident that the range of the illuminated area is widely different from the range of the target. If it is apparent that an error has been made in azimuth, he commands: SEARCH RIGHT (LEFT). If one searchlight of several assigned to a target picks it up, the

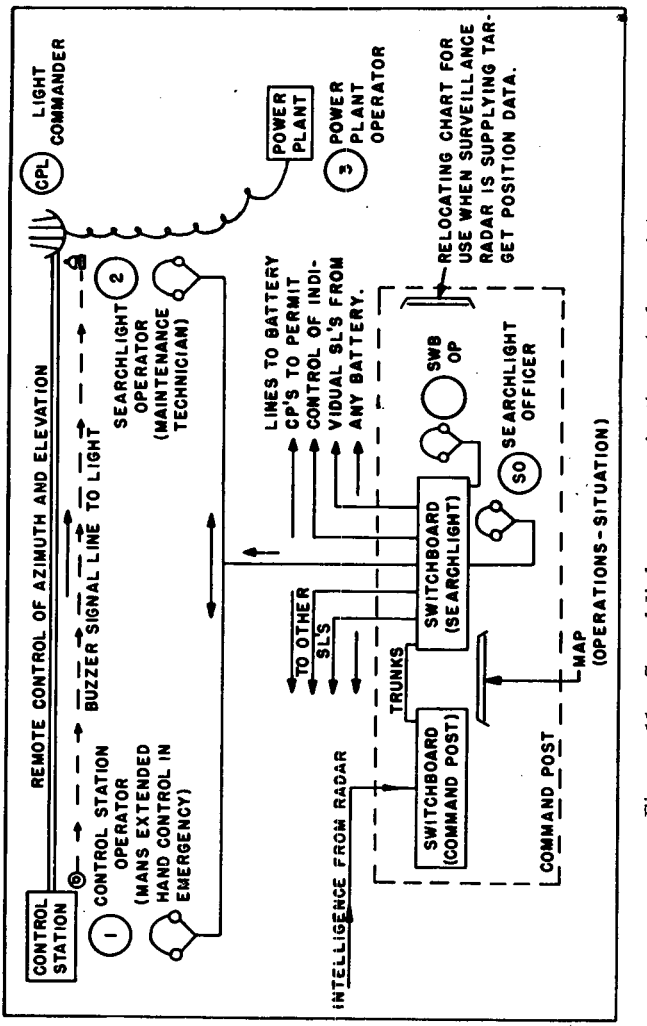

Figure 11. Searchlight communications (schematic).

searchlight officer commands: COVER, thus indicating that the other lights are to cover the illuminated target. If the nature of the error is doubtful, he orders one searchlight to search the area in which the target is believed to be. He directs at the other searchlights the command: OUT, prior to the investigation of the error. When the target has been picked up, the searchlights assigned to it track in accordance with principles set forth in FM 4–5.

d. Assignment and pickup of motor torpedo boat targets. During the searching phase, the searchlight assigned to the AMTB battery may be controlled by the searchlight officer in the manner outlined in subparagraph c. When a particular target is to be engaged by the AMTB battery, control of the AMTB searchlight is exercised by the battery commander.

(1) Position data for pointing the AMTB searchlight will be obtained initially from higher headquarters (surveillance radar). If control is relinquished to the battery commander before the light is put in action, position data will be determined during the interval by the radar set assigned to the battery.

(2) Because of the speed and maneuverability to be expected of motor torpedo boats, elapsed time between the assignment of targets and the turning on of the searchlight must be kept to a minimum. Whenever motor torpedo boats are detected in the area covered by the harbor defense radar, the AMTB searchlight is ordered to STAND BY with power on and the DEC system oriented and synchronized. When it becomes apparent that a target being tracked by radar is following a course which may bring it into the battery's field of fire, azimuths determined by radar and relocated on a board in the BC station should be relayed to the searchlight at frequent intervals. Each time, the searchlight should be traversed to the indicated azimuth by distant electric control. The light commander should check each time to see that the proper reading appears on the

azimuth scale at the searchlight. When it is desired to place the light in action, the battery commander commands: IN, AZIMUTH (relocated azimuth with no allowance for dead time).

(3) The searchlight beam will be spread at the order of the battery commander for illumination of motor torpedo boat targets at ranges less than 5,000 yards. In addition to facilitating the task of tracking high-speed, maneuvering targets, the added beam width compensates for errors in radar azimuth data and for any possible delay in relaying data from the radar station to the searchlight.

e. Employment of spread-beam lenses. (1) The searchlight beam is spread whenever a high-speed, maneuvering target is to be tracked at a range less than 5,000 yards. (Use of the spread-beam lenses reduces the maximum expectable range of the searchlight about 35 percent.) The increased width of the beam reduces the possibility of a target escaping illumination by maneuvering and facilitates spotting of the fall of shots.

(2) Searchlights equipped with spread-beam lenses may also be used for rapid searching of close-in water areas and illumination of beach defense areas.

(3) The change from normal to spread beam or from spread to normal beam is made at the command of the officer exercising searchlight control, who commands: (Searchlight number) SPREAD (CONTRACT) when he desires that the change be made. The command SPREAD may be combined with the command STAND BY or the command IN (Searchlight number, SPREAD, IN), if it is apparent that the target to be illuminated will be at a range less than 5,000 yards from the searchlight when the searchlight is placed in action.

(4) Modified spread-beam performance (longer ranges with a narrower beam) may be achieved by closing two of the four spread-beam lenses. The two-lens combinations likely to be useful are the two lower lenses, the two upper lenses, or two diag-

onally opposite lenses. If spread-beam operation is desired at extreme ranges, the usable range of spread-beam searchlights can be further increased by directing two or more spread beams on the same area. The decision to employ any of these expedients depends on the local situation. Circumstances in which two-lens operation will be used and designation of the lenses to be employed should be part of local SOP. The appropriate command for two-lens operation is SPREAD ONE-HALF.

f. References. The employment of seacoast artillery searchlights is discussed in detail in FM 4–5.

18. EMERGENCY ANTIAIRCRAFT ARTILLERY ROLE. a. Missions. Seacoast artillery searchlights have the equipment necessary to act as—

(1) Carry lights in the local antiaircraft searchlight defense.

(2) Carry lights or control point markers in an antiaircraft belt defense of a coastal frontier.

(3) Pickup lights where assigned to AMTB batteries equipped with SCR–268 or radar set AN/TPL–1.

b. References. For particulars of searchlight employment in the missions mentioned above, see FM 44–6 and FM 4–5.

CHAPTER 4

DUTIES OF PERSONNEL

19. PLATOON COMMANDER. The platoon commander is responsible for—

a. Training of personnel. He is charged with seeing that personnel receive thorough training in the operation of materiel, its care and maintenance, and destruction. He must assure himself that the chiefs of section and light commanders under his command are thoroughly conversant with the tactics and technique of searchlight operation.

b. Emplacement and maintenance of equipment. He will supervise the emplacement of searchlights, searchlight equipment, and machine guns on sites selected by higher authority, or will himself select sites satisfactory for the performance of missions assigned by higher authority. He will assure himself, by frequent inspection, that equipment under his control is properly serviced and maintained by searchlight personnel.

c. Camouflage of equipment. Within the limitations prescribed by higher headquarters, he will select sites suitable for camouflage. He will prescribe the type of camouflage to be used, and will assure himself, by frequent inspections, that camouflage discipline is being observed.

d. Tactical efficiency of the searchlight squads under his command. At every opportunity, he will check the ability of the searchlight personnel to orient and synchronize their instruments, and their ability to detect and track targets. He will direct and supervise training to correct deficiencies discovered by these checks.

e. Administrative duties with regard to mess, supply, transportation, reports, and medical care.

f. Maintenance of high morale among personnel.

20. PLATOON SERGEANT. The platoon sergeant—

a. Assists the platoon commander in the performance of his duties.

b. Takes command of the platoon in the absence of the platoon commander.

21. CHIEF OF SECTION (SECTION LEADER). The chief of section—

a. Receives and passes on commands of the platoon commander and the platoon sergeant relative to his section.

b. Assumes responsibility for the tactical and technical performance of men assigned to his section under circumstances which remove him from the direct supervision of the platoon commander and the platoon sergeant.

c. Supervises, under the direction of the platoon commander, the occupation and organization of positions by searchlight squads assigned to his section.

d. Assists the platoon commander in training operating personnel.

e. Supervises first echelon maintenance of transportation assigned to his section.

22. LIGHT COMMANDER. The light commander—

a. Has direct control of the searchlight squad during tactical operation.

b. Is responsible for the proper execution of the commands of the searchlight officer.

c. Supervises orientation and synchronization of the searchlight system daily at nightfall and directs checks on orientation at frequent intervals (orientation should be checked each time power is turned on if power is turned off after initial daily orientation).

d. Reports failure of the distant electric control system and regroups his squad for extended hand control operation.

e. Acts as an observer during operation under extended hand control, taking station 50 to 100 feet to the flank of the searchlight. From this position, he directs the extended hand control operator by voice command during detection and tracking of targets. (An observer displaced from the light in this manner can see targets more clearly than the operator at the extended hand controller.)

f. Supervises first echelon maintenance of the searchlight, control station, and power plant.

23. CONTROL STATION OPERATOR. The control station operator—

a. Mans the control station during tactical operation using distant electric control.

b. Mans the extended hand controller in the event of failure of the distant electric control system.

c. Orients the control station on a selected orienting point when directed to do so.

d. Performs first echelon maintenance of the control station.

24. POWER PLANT OPERATOR. The power plant operator—

a. Starts and stops the power plant when directed to do so and supervises its operation while it is running.

b. Manipulates the power plant controls to maintain proper readings on the meters.

c. Operates the power plant manually in the event of failure of the automatic controls.

d. Performs first echelon maintenance on the power plant.

25. SEARCHLIGHT OPERATOR. The searchlight operator—

a. Observes the arc continually during operation and makes necessary adjustments.

b. Places the light in operating condition immediately upon occupation of a position.

c. Observes the searchlight arc meters continually during operation and makes adjustments necessary to maintain the arc current at 150 amperes and the arc voltage at 78 volts.

d. Orients the searchlight on a selected orienting point whenever directed to do so.

e. Performs first echelon maintenance on the searchlight.

26. ELECTRICIAN. The searchlight electrician—

a. Performs second echelon maintenance on searchlight and control station equipment.

b. Performs second echelon maintenance on the electrical system of the power plant.

27. COMMUNICATIONS SECTION. a. The communications section of a harbor defense searchlight platoon—

(1) Installs and maintains any field telephone lines operated by the platoon.

(2) Aids in maintaining tactical lines as may be directed by the searchlight battery commander.

b. The communications section of headquarters battery of a 155-mm gun battalion installs communications for the searchlight platoon of headquarters battery.

28. TRUCK DRIVERS. Truck drivers assigned to searchlight sections in mobile artillery organizations—

a. Perform first echelon maintenance on trucks and trailers assigned to the section.

b. Drive trucks assigned to the section as required.

29. MACHINE GUNNERS. Machine gunners assigned to local protection of seacoast searchlights—

a. Site their machine guns as directed by the platoon commander.

b. Clean and lubricate their machine guns daily.

c. Check head space daily.

d. Open fire on enemy aircraft, boats, or ground targets if attacked or when directed to do so by the platoon leader.

CHAPTER 5

NOTES ON SERVICE OF THE SEARCHLIGHT

Section I. OPERATION

30. GENERAL. The principal technical problems of searchlight operation are lamp control, synchronization and orientation of the set, operation of the DEC system, and extended hand control. These problems, although basic to operation of seacoast searchlights, vary somewhat with different searchlight models and will be discussed only generally here. Each is covered in detail in the technical manual describing the searchlight model concerned. The manipulation of spread-beam lenses, a problem peculiar to seacoast artillery searchlight equipment, is discussed in detail herein.

31. LAMP CONTROL. **a.** Lamp control requires the correct positioning of the positive and negative carbons with respect to each other and with respect to the lamp head (fig. 12). When the lamp control mechanism is functioning properly, the carbons are positioned automatically. In the event of failure of the automatic control system, semiautomatic or manual control (app. II) may be used. Whenever the searchlight is in operation, the searchlight operator must monitor the arc continually, using the peep sights and the ground-glass finder for the purpose.

b. The carbons must be positioned so that—

(1) The positive carbon protrudes 11/16 inch from the positive nose cap (Sperry). Protrusion of as much as ¾ to ⅞ inch is permissible on General Elec-

tric searchlights. This is checked by viewing the positive carbon through the ground-glass finder. The tip of the carbon should be at the black line on the finder. *It must never be permitted to burn back to the red DANGER line on the finder.*

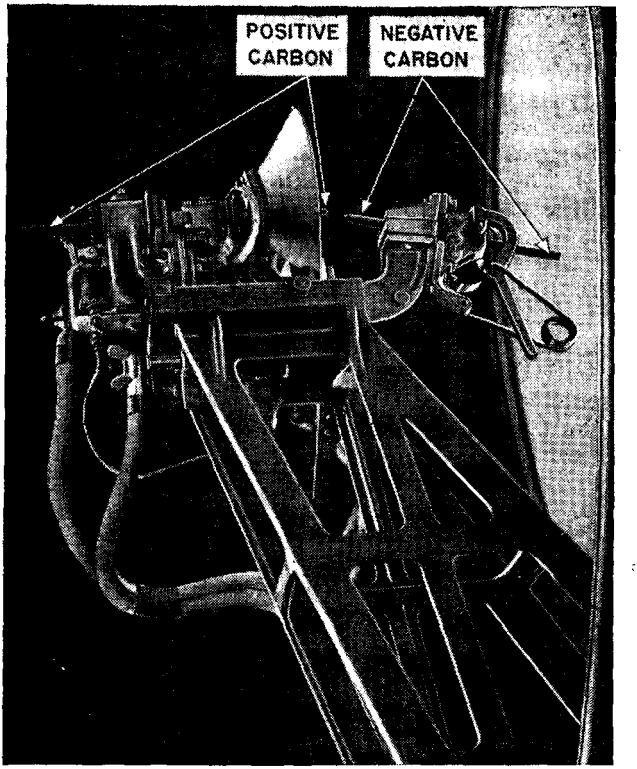

Figure 12. Lamp (equipped with AA spread-beam device).

(2) The tip of the positive carbon is maintained at the focal center of the mirror. The tip of the positive carbon is the actual light source of the

searchlight. If it is displaced only ⅛ inch from the focal center of the mirror, the beam candlepower of the searchlight is reduced 40 percent, which reduces the effective range by 20 percent. The proper position of the positive carbon tip is marked by the black line on the ground-glass finder. If it is off this line because of insufficient protrusion from the positive nose cap, adjust the positive feed mechanism. If positive carbon protrusion (viewed through the peep sight) is correct, adjust the focusing knob or the spread-beam handwheel to bring the carbon to the proper position.

(3) The correct arc length (distance between the positive and negative carbons) is maintained. This is determined by the readings of the arc voltmeter and the arc ammeter on the trunnion arms of the searchlight. When the arc length is correct, arc current is 150 amperes and arc voltage is 78 volts.

c. When the lamp is turned on (by closing the arc switch), the negative carbon must feed forward until it touches the positive carbon and then retract at once to the proper arc length. This is known as *striking the arc.* It is usually accomplished automatically whenever the arc switch is closed. In the event of failure of the automatic mechanism, it can be accomplished manually by feeding the negative carbon until contact has been made and immediately retracting the negative carbon until the proper current and voltage values are read on the arc meters.

d. The useful life of a pair of carbons is about 1½ hours of operation. Whenever the lamp is turned off, and at frequent intervals during operation, the carbons should be inspected (through the peep sights) to make sure that they are sufficiently long. When the blunt end of either carbon is seen to be within 2 inches of the lamp head, the carbon should be replaced. Recarboning is accomplished as follows:

(1) Enter the drum. *Make sure that the DEC system is deenergized or disconnected from the searchlight.* (Methods of disconnecting the DEC

system differ with different searchlight models. See appropriate technical manuals.) If recarboning is being done at night, the recarboning lamp should be lighted.

(2) Remove used carbon stubs, using recarboning tongs to handle the stubs (if the lamp has just been in operation, they will be extremely hot). The carbon stubs may be disengaged by manipulation of the positive and negative carbon release levers (nomenclature of these levers differs with different searchlight models). If necessary, the carbon stub may be dislodged by inserting the new carbon behind it between the feed rollers and pushing forward until the stub can be grasped by recarboning tongs. *Do not drop carbon stubs or new carbons on the mirror.*

(3) Insert new carbons between the feed rollers. *Full-length, unused carbons should always be used for recarboning and both carbons should always be replaced at the same time.* Adjust the protrusion of the positive carbon beyond the positive nose cap (par. 31*b*). Position the negative carbon so that its tip is fairly close (¼ to ½ inch) to the tip of the positive carbon (this adjustment is not critical).

(4) As each carbon is inserted, engage it with the feed rollers by restoring the release lever to its operating position. Do not allow the release lever to snap back into place as this may break the carbon.

(5) Leave the drum, close drum doors tightly, turn out the recarboning lamp, and reengage the DEC system.

(6) Reorient the light with the control station. The searchlight is now ready for operation.

e. Details of semiautomatic and manual operation of the Sperry and General Electric M1942 searchlights, with appropriate nomenclature for the two models, will be found in appendix II. For earlier models of either type, see appropriate technical manuals (app. I).

32. SYNCHRONIZATION AND ORIENTATION.

a. General. Operation of the searchlight by distant

electric control is possible only after the DEC system has been actuated, synchronized (so that an angular movement of the control unit causes an equal angular movement of the searchlight in the same direction), and oriented (so that azimuth circles on both searchlight and control station read the correct azimuth of the searchlight beam at all times).

b. Actuating the DEC system. A number of controls must be operated in order to actuate the DEC system of a searchlight. The nomenclature of the controls operated and the operations performed vary somewhat for different searchlight models. This paragraph outlines the necessary procedures for M1942 searchlights of both types. For other searchlight models, see appropriate technical manuals.

(1) The DEC system of the Sperry M1942 searchlight is actuated when the power is on, the cables are connected, all drum doors are closed, the DEC transfer switch (at the control station) is set at MANUAL, the dynamotor switch (in the junction box) is set at DYNAMOTOR, the azimuth clutch lever is set at OPER, the elevation clutch handle is set to MOTOR DRIVE, the elevation lock handle is set at OPER, and the DC switch (on the junction box) is ON.

(2) The DEC system of the General Electric M1942 searchlight is actuated when the power is on, the cables are connected, the DEC transfer switch is set at MANUAL, the AC selector switch is set at DYNAMOTOR, the azimuth and elevation clutch levers are set at DEC, the elevation brake is OFF, and the azimuth and elevation amplidyne switches are ON.

c. Synchronization. Model 1942 searchlights are synchronized as follows: Adjust the controls for DEC operation (subpar. *b* above), but do not turn ON the DC switch (Sperry) or the azimuth and elevation amplidyne switches (General Electric). (If any of these switches is ON, injury to personnel or damage to materiel may result.) Now rotate the observer's azimuth handwheel at the control station until the needle on the azimuth zero reader at the searchlight

is on the zero index. (Check to see that clockwise movement of the control unit causes a right deflection of the zero reader needle.) Rotate the observer's elevation handwheel at the control station until the needle on the elevation zero reader at the searchlight is on the zero index. (Visual signals—hand by day or flashlight by night—are used by the light commander to indicate to the control station operator the amount and direction of the necessary movement of the handwheels.) Turn ON the DC switch (Sperry) or the azimuth and elevation amplidyne switches (General Electric). The searchlight may jump slightly. The searchlight and control station are now synchronized. (*Note.* Synchronization is the only purpose for which zero readers are used in seacoast searchlight operation. This is possible on M1942 searchlights because the zero readers at the searchlight indicate the position of the searchlight with respect to the control station. On earlier searchlight models, the zero readers at the searchlight indicate the position of the searchlight with respect to the detector.)

d. Orientation. For seacoast artillery purposes, the searchlight and control station must be oriented in azimuth (to the nearest degree) on a distant datum point. Model 1942 materiel is oriented as follows: Aim the searchlight manually at the orienting point, using the orientation sight. Synchronize searchlight and control station (subpar. c above). If the searchlight line of sight jumps off the orienting point when the azimuth and elevation drive subsystems are energized (by closing the DC or amplidyne switches), use the azimuth synchronizing crank (Sperry) or the azimuth corrector knob (General Electric) to move the line of sight back to the orienting point. Slip the azimuth scale of the searchlight to read the azimuth of the datum point. Slew the control unit until the azimuth circle at the control station reads the azimuth (from the searchlight) of the orienting point. When these steps have been carried out, the searchlight and control station are oriented.

e. Checks of synchronization and orientation. The searchlight set is synchronized and oriented daily just before dark. The synchronization and orientation of the set must be checked each time power is applied (if power is turned off after the initial synchronization and orientation). At the command STAND BY, the light commander of a squad operating M1942 equipment supervises the setting of the controls for DEC operation. Before the DC switch (amplidyne switches) is turned ON, he checks to see that the zero readers at the searchlight are centered. If they are not, he commands: (Searchlight number), CONTROLLER, SYNCHRONIZE over the telephone and then uses visual signals to indicate to the control station operator the amount and direction of movement necessary. When the readers are centered, he reports, "(Searchlight number), azimuth (reading of searchlight azimuth scale)." The control station operator then slews the control unit (if necessary) to read the azimuth indicated, and the system is oriented and synchronized.

33. DISTANT ELECTRIC CONTROL. a. General. The searchlight beam can be moved to any point in the area it covers by movement of the observer's azimuth and elevation handwheels, when the DEC system has been actuated, synchronized, and oriented (par. 32). In operation, the searchlight is initially set to a point in elevation (determined by experimentation) which affords maximum illumination of the water area to be covered. An initial azimuth is ordered by the officer exercising searchlight control. When a target is picked up, the searchlight is elevated or depressed until illumination of the water area between the searchlight and target is reduced to a minimum, and moved in azimuth as necessary to provide maximum visibility for observers (FM 4–5). The target is tracked by moving the azimuth and elevation handwheels at the control station as necessary to keep the target in the searchlight beam. If

the control station operator is following the target through a binocular mounted on the control station, he slews the binocular mount independent of the control station as necessary in order to keep the target in view.

b. Illumination of targets. (1) When a target is assigned by the searchlight officer (par. 17c), the control station operator moves the control unit, by means of the observer's azimuth handwheel, to the azimuth directed and acknowledges the command by reporting over the telephone, "(Searchlight number), controller, (azimuth directed)." (If more than one searchlight is concerned, control station operators report in order of the searchlight numbers—light 1 before light 2, etc.) The searchlight operator checks to see that the azimuth scale on the searchlight reads the proper azimuth. If it does, the searchlight operator reports, "(Searchlight number), in order," and the searchlight officer commands: (Searchlight number), IN. If the searchlight azimuth scale reads incorrectly, the searchlight operator reports, "(Searchlight number), DEC out of order," and the control station operator and light commander take posts for extended hand control (par. 34).

(2) *Examples.* (*a*) The searchlight officer desires to illuminate a target, crossing right to left with respect to the searchlight, which is being tracked by surveillance radar. The relocated azimuth from searchlight 4 to the target is 270, and the plotted course of the target indicates that it will travel about 1°, with respect to the searchlight position, during 20 seconds [this need not be accurate, due to the beam width of the searchlight and the 10° sector of search specified in par. 33*b* (3)]. The searchlight officer commands: FOUR, AZIMUTH TWO SIX NINE. The control station operator at searchlight 4 traverses the control unit until its azimuth circle reads 269, and reports, "Four, azimuth two six nine." The searchlight operator observes that the azimuth scale

on the searchlight reads 269 (any reading between 268 and 270 is satisfactorily accurate), and reports, "Four, in order." The searchlight officer commands: FOUR, IN.

(*b*) If the reading of the azimuth scale at the searchlight is incorrect, the searchlight operator reports, "Four, DEC out of order." The light commander and control station operator take posts for extended hand control (par. 34), and the searchlight operator reports, "Four, hand control in order." The searchlight officer then commands: FOUR, IN, AZIMUTH TWO SIX ZERO (giving a relocated azimuth with no allowance for dead time). The searchlight is moved manually to the azimuth directed, and the searchlight operator turns on the lamp. [The target is then picked up as prescribed in paragraphs 17c and 33*b* (3).] As soon as the tactical situation permits, the searchlight is turned off and the DEC is checked to determine the cause of the malfunction.

(3) When the searchlight is turned on, the control station operator looks for a target in the beam. If none is visible, he immediately searches through 5° on either side of the azimuth at which the light was ordered IN. If no target is detected in the 10° sector of search, the searchlight squad awaits further orders from the searchlight officer (par. 17c), meanwhile continuing a systematic search in the 10° sector.

34. EXTENDED HAND CONTROL. Extended hand control is used only when distant electric control fails (par. 33). After reporting "DEC out of order," the searchlight operator sets the controls for extended hand control (app. II). The light commander and searchlight operator place the extended hand controller in its socket, mesh it with the elevation gearing, and check its operation. The searchlight is then operated by hand control as specified in paragraph 33, with the light commander operating the extended hand controller and the searchlight operator performing his usual task of monitoring the per-

formance of the searchlight. The control station operator comes from the control station to the searchlight as rapidly as possible. When the control station operator arrives, the light commander turns over the extended hand controller to him and takes post approximately 50 feet to the flank, as an observer. Personnel continue to perform these tasks as long as extended hand control is necessary.

Section II. SPREAD-BEAM LENSES

35. MANIPULATION. a. General. The searchlight operator changes the spread-beam lenses from the normal (or spread) beam to the spread- (or normal-) beam position, as outlined in subparagraphs *b* and *c* following, at the command of the officer exercising searchlight control (subpars. 17*d* and 17*e*). The operations necessary to change the position of the lenses are simple and are readily apparent from an inspection of the hinge construction. (See details of hinge construction in figs. 13 and 14.) It is desirable, however, to establish and practice a standard procedure in order to attain speed and dexterity. The following paragraphs outline a suggested procedure for changing the position of the lenses.

b. Changing from normal to spread beam. (1) Release the holding hooks on the upper and lower lenses. Standing to the right of the light (fig. 15), grasp the bottom of the lower lens with the right hand and the top of the lens with the left hand. Lift the lens from the locking slot, rotate it until its plane is parallel to the beam of the light, then push the top of the lens with the left hand and allow the holding rod to move down the slotted track of the upper bracket to the end of the slot. Next, close the lens into the spread-beam position, and lower it into the locking slot.

(2) To move the upper lens, grasp it with both hands and lift it from the locking slot. Close the lens into the spread-beam position and lower it into the locking slot.

(3) Move across the front of the light to left side and repeat the same series of operations for the lower and then the upper lens, with the positions of the right and left hands interchanged.

Caution: Do not look directly into the arc flame of the lamp or the reflection of the arc in the mirror.

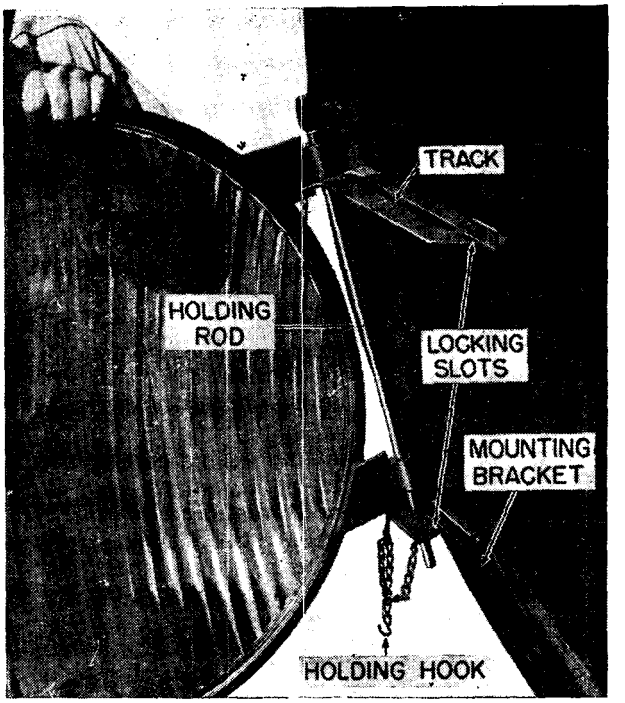

Figure 13. Mounting of spread-beam lenses (lower lens).

(4) Note that the holding hooks are not reengaged as a part of the procedure above. Under service conditions, the holding hooks should be reengaged as soon as possible after the beam has been spread (contracted) and the searchlight is again following

the target smoothly. In training, the holding hooks should be reengaged as soon as all four lenses have been opened or closed. The searchlight should never be operated for any length of time with the holding hooks disengaged, as there is always a chance of the lens slipping from the locking slot and damaging the equipment.

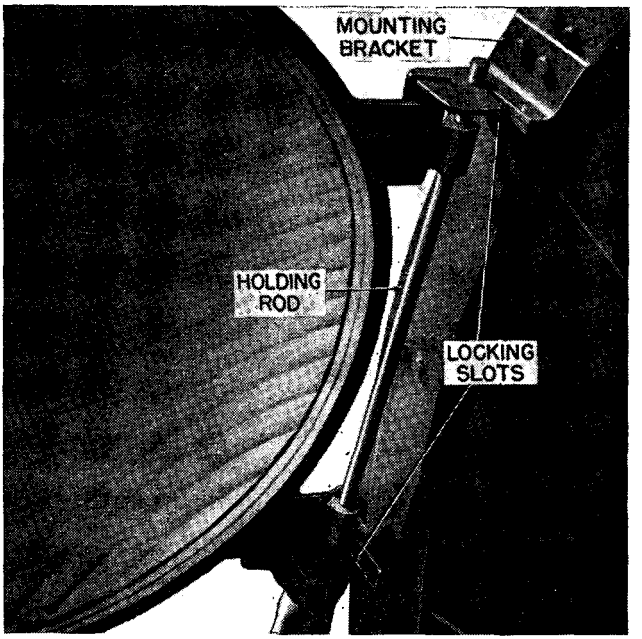

Figure 14. Mounting of spread-beam lenses (upper lens).

c. Changing from spread beam to normal beam. Reverse the operations listed under *a* preceding, being sure to open the upper lens first and then the lower lens, first on one side and then the other.

d. Priority of operations. When the searchlight is not in use, or during periods when the squad is at

REST, the lenses are kept in the spread-beam position. At the command STAND BY, the lenses are opened, unless otherwise ordered by the searchlight officer or otherwise specified in local SOP. When the command SPREAD (CONTRACT) is combined with another command (par. 17*e*), the searchlight operator manipulates the lenses only after performing all other actions directed by the command (i.e., after the DEC system has been synchronized and oriented at the command STAND BY or after the lamp has been turned on at the command IN).

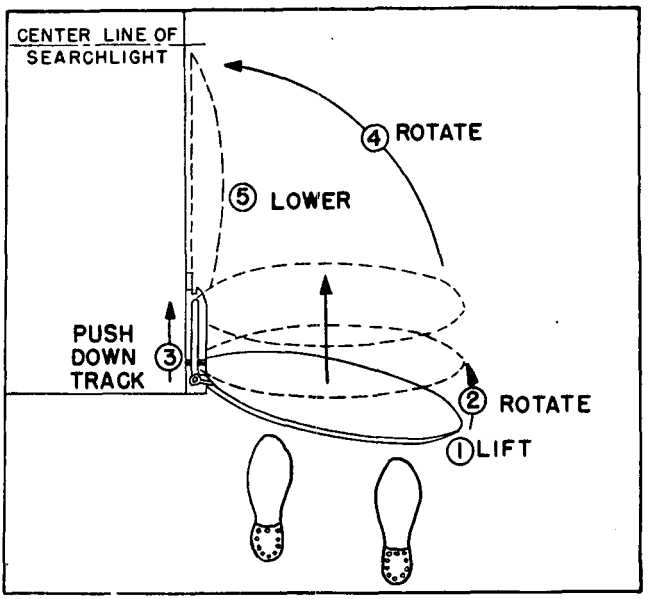

Figure 15. Manipulation of spread-beam lenses.

36. TRANSPORTATION. When the searchlight is to be transported by truck, trailer, or shipped from one place to another, the spread-beam lenses (with holdings rings), the lens-holding rods, and the coun-

terweights must be removed and packed in the carrying case provided for the purpose. The mounting brackets and the counterweight holding frame and crank need not be removed from the searchlight.

a. Removing spread-beam equipment. (1) Set the searchlight drum at an elevation of 0 mils and lock the elevation brake.

(2) Remove the upper lenses. Each lens is removed by taking the cotter pin out of the holding rod and withdrawing the holding rod. (Hold the lens securely to prevent it from falling.) Then remove the lens and holding ring and place them in a safe place near the carrying case.

(3) Remove the lower lenses. The lower lenses are removed in the same manner as the upper lenses (subpar. (2) preceding).

(4) Release the counterweights by turning the holding crank counterclockwise. Remove the counterweights from the holder and turn the holding crank clockwise as far as it will go without damaging the searchlight drum. Care should be taken to protect the counterweight assembly against any jarring blows as the assembly may be dislodged from the drum.

b. Packing spread-beam equipment. (1) Remove all accessories from the lens carrying case and then pack the equipment in the carrying case in the following order:

(*a*) Counterweights.
(*b*) Lens-holding rods.
(*c*) Lens holder shelf.
(*d*) Spare lens (place flat on holder shelf).
(*e*) Wooden blocks.
(*f*) Lenses.

(2) To pack the lenses, proceed as follows:

(*a*) Place one wooden block in each corner of the case, with the cut-out portion on the bottom and the hole in the block fitting over the wood dowel in the shelf. Match the color of the dots on the block and the case.

(*b*) Place one lens, complete with holding ring, on the four corner blocks.

(*c*) Pack the remaining lenses, using corner blocks to separate each lens from the others. (Corner blocks for each lens are placed as in (*a*) above.)

(*d*) Place one block in each corner of the case on top of the last lens packed. This is necessary because the springs mounted on the lid must engage these blocks to keep the lenses in place.

(*e*) Close the top carefully.

c. Reassembly of spread-beam equipment. (1) Set the searchlight drum at an elevation of 0 mils and lock elevation brake.

(2) The procedure for unpacking and reassembling spread-beam equipment is essentially the reverse of the procedures outlined in *a* and *b* above. Corner blocks, spare lenses, and lens holder shelf are replaced in the carrying case after other equipment has been unpacked.

Section III. POWER PLANT OPERATION

37. GENERAL. **a.** Operation of the searchlight power plant is essentially the same as operation of any portable power plant. After starting the power plant and making cable connections necessary to supply power to the searchlight, the power plant operator stands by the plant, watching for malfunction of the equipment and making such control settings as are necessary to supply proper control and arc power to the searchlight.

b. The following paragraphs outline procedures for power plant operation. For detailed procedures, see the appropriate technical manuals (listed in app. I).

38. STARTING THE POWER PLANT. **a.** The power plant is started in the same manner as an automobile engine, by turning on the ignition, adjusting choke and throttle controls, and manipulating the

starter until the engine catches. The front door of the power plant should be open to provide a flow of air for the cooling system. If the electric starting system should fail, the power plant can be started by using the crank supplied with the equipment. When the engine is running, the choke is adjusted as necessary for smooth operation. After a few minutes of smooth running, the throttle is pulled to the wide-open position. Engine speed, as indicated on the tachometer, should approximate the no-load value for the power plant being used. (See table, par. 42.) If the tachometer reading with the throttle wide open is considerably more than the no-load value, the power plant must be operated manually. Before starting the power plant, the operator should check to make sure that the main power switch is OFF. This switch must never be turned ON until all cables have been connected and power is to be supplied to the searchlight.

b. Whenever the power plant is started, it should be run long enough to bring the engine up to operating temperature before being stopped.

39. CABLE CONNECTIONS. The two power cables are connected from the output receptacles on the power plant to input receptacles on the junction box of the searchlight. The cables may be connected either before or after the power plant has been started.

40. CONTROL-LOAD OPERATION. After the power plant has been started and adjusted to no-load operating speed and the cables have been connected, output voltage of the power plant should be adjusted to a preliminary voltage (listed under no-load values in the table, par. 42). The main power switch is turned ON when ordered by the light commander. (The arc switch at the searchlight should be OFF when the main power switch is first turned ON.) The operator checks to see that the output meters

read control-load values, adjusting the rheostat if necessary.

41. ARC-LOAD OPERATION. After control operation of the power plant and the DEC system have been checked, the arc should be struck. Output voltage and engine speed at the power plant will decrease when the lamp is turned on. The field rheostat should be adjusted to obtain the arc-load reading (see table, par. 42) on the power plant voltmeter. The governor should adjust engine speed automatically to the proper value.

42. OPERATING VALUES. **a.** The following table lists approximate values of voltage, current, and engine speed for different operating conditions for the 1942 models of both types of searchlights:

	Power plant voltmeter (volts)		Power plant ammeter (amperes)		Tachometer (r.p.m.)		Searchlight voltmeter (volts)		Searchlight ammeter (amperes)	
	Sperry	*G.E.*	*Sperry*	*G.E.*	*Sperry*	*G.E.*	*Sperry*	*G.E.*	*Sperry*	*G.E.*
No-load values.....	105	110	0	0	1, 150	1, 250	0	0	0	0
Control-load values.	105	110	15	15	1, 150	1, 250	105	110	0	*0
Arc-load values....	100	100	165	165	1, 100	1, 190	78	78	150	150

b. If it is impossible to obtain the readings listed above on all meters during arc-load operation, the power plant output should be adjusted as necessary to obtain the proper readings on the searchlight voltage and current meters. Arc voltage must be maintained at 78 ± 2 volts and arc current must be maintained at 150 amperes for efficient operation.

c. Engine meters on the control panel of the power plant should read within the following limits: water thermometer, 160°–180°; oil pressure, 15–25 pounds. The charging ammeter may read between +5 and +15 amperes (Sperry) or between 0 and +25 amperes (General Electric), depending on the state of charge of the battery.

43. MANUAL OPERATION. If governor control of engine speed should fail, the governor should be blocked or tied in its wide-open position and engine speed maintained at proper values by adjustment of the throttle control.

Note. When the power plant is operated manually, the operator must push in the throttle quickly when changing from arc-load to control-load operation (whenever the lamp is turned off). Failure to do this will cause the engine to overspeed, generating a high voltage which will burn out motors and lamps.

44. STOPPING THE POWER PLANT. The following procedure should be followed in shutting down the power plant:

a. Turn off the main power switch.

b. Push in the throttle and allow the engine to idle for 10 to 15 minutes.

c. Turn off the ignition switch.

d. Turn off panel lights and close engine and control panel doors.

e. Disconnect power cables and cover receptacles.

45. TRANSPORTATION. The power plant should be prepared for transportation by turning off all control panel switches, closing and latching or locking all doors on the unit, and closing and latching the tool box. Tire pressure should be checked. (The proper tire pressure is 32 pounds.)

Section IV. SAFETY PRECAUTIONS

46. GENERAL. a. The same precautions should be observed in operating searchlight equipment as are observed with any high-current apparatus. The equipment is designed for a maximum of safety, but constant checks must be made on the condition of the wiring system and the protective systems to forestall short circuits or mechanical malfunctions which might cause injury to personnel or damage to equipment.

b. In addition to the specific precautions mentioned elsewhere in this manual, the following safety measures should be observed scrupulously:

(1) Keep clear of the searchlight when it is being moved by distant electric control. The azimuth and elevation drive mechanisms have sufficient power to cause serious injury to anyone struck by the drum when it is moving rapidly. The duties of the searchlight operator may require him to approach the drum while it is being traversed electrically, but he should do so with caution.

(2) Keep clear of exposed electrical apparatus. If the searchlight is being operated with one or more of its control elements uncovered, points of dangerously high voltage may be exposed. Voltages as high as 440 volts develop in azimuth and elevation control and drive elements of a 1942 searchlight when the searchlight is moving rapidly.

CHAPTER 6

FIELD OPERATIONS

47. SELECTION OF POSITIONS. a. Tactical considerations. For tactical considerations affecting the siting of Coast Artillery searchlights, see FM 4–5.

b. Positions for other elements of the searchlight set. After a position satisfying tactical requirements has been selected for the searchlight, positions should be chosen for other elements of the searchlight (fig. 16). The control station should be located on either flank of the searchlight as far from the searchlight as the control cable permits and at a height approximately 20 feet lower than the searchlight. The control station may be located in a base-end station if convenient. The power plant should be sited in a direction away from the shore line as far from the searchlight as the power cables permit. (Additional 200-foot lengths of power cable may be added to the issue cables up to a total length of 600 feet. The ballast resistor must be adjusted for operation with 400 or 600 feet of cable.) Power plant and control station sites should be widely separated. The machine gun assigned for local defense of the searchlight should be sited 50 to 100 yards from the searchlight in a position affording good fields of fire against low-flying aircraft, motor torpedo boats, and ground avenues of approach. If no single position fulfilling these requirements can be found, supplementary positions should be designated. Alternate positions for primary and supplementary positions should be designated. The platoon commander, in his ground reconnaissance, should also designate bivouac areas for searchlight personnel.

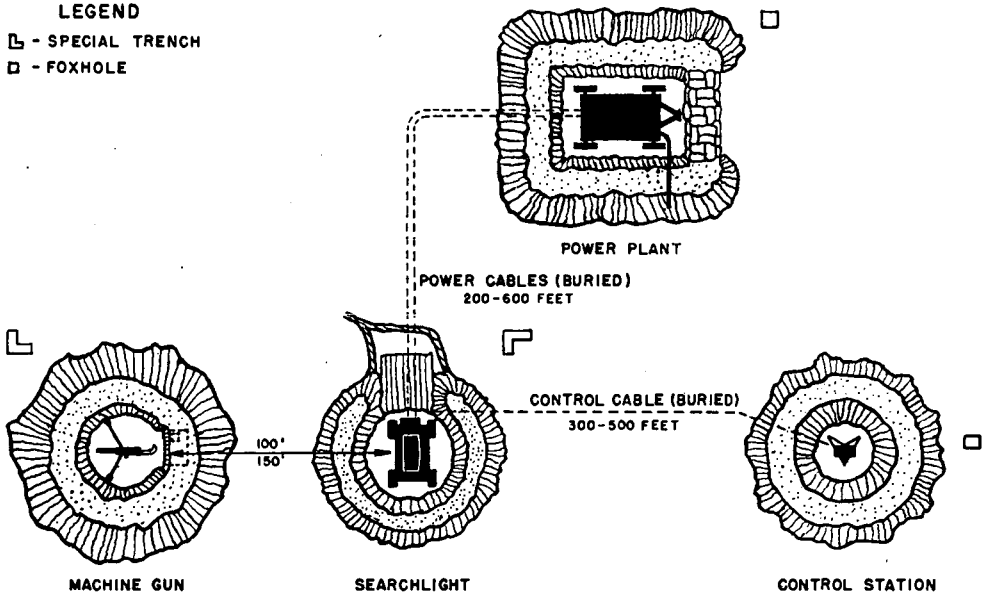

Figure 16. Field emplacement of searchlight set (camouflage omitted).

48. OCCUPATION AND ORGANIZATION OF POSITION. **a.** Following the selection of a site by the platoon commander, detailed information as to the sites selected for the elements of the searchlight set should be passed on to section leaders and light commanders. Movement into position will be directed by section leaders and light commanders, supervised by the platoon commander and the platoon sergeant.

b. Members of the searchlight squad should be trained in a standing operating procedure for speedy occupation of field positions. This is particularly important in the case of semimobile organizations where the scarcity of transportation requires a high degree of efficiency in its use. A suggested SOP for movement into position follows:

(1) Equipment should be loaded as follows: extended hand control and spare carbons in the searchlight trailer; control station (including binocular mount), telephones, control cable, and power cables in the truck towing the searchlight; machine gun and ammunition chests in the truck towing the power plant. (See FM 44–75.) If strafing or low-level bombing attack is considered likely en route to the position, the machine gun should be carried in firing position, manned and ready, throughout the movement. If the move is to be a long one over rough roads, it may be necessary to carry the power plant in the truck rather than tow it. It will not be possible to carry the power plant and mount the machine gun in the same truck.

(2) Personnel should be carried as follows: light commander, searchlight operator, and control station operator in the truck towing the searchlight; machine gunners and the power plant operator in the truck towing the power plant. The section leader should ride with the first squad of his section to move into position. The platoon leader and the platoon sergeant should have the use of one of the battery administrative vehicles during movement into position.

(3) The truck towing the searchlight proceeds to the searchlight position (or as near to it as terrain and camouflage discipline will permit). The trailer is uncoupled and the searchlight and a telephone are unloaded and prepared for operation. The searchlight operator remains with the searchlight. The truck proceeds to the position selected for the control station, unreeling the control cable and telephone wire as it goes. At the selected site, the control station and the other telephone are unloaded and set up. The control station operator remains with the control station. The truck then returns to the searchlight position and moves from there to the power plant position, unreeling the power cables.

(4) The power plant truck proceeds to the power plant position, where the power plant is uncoupled (or unloaded). The truck then proceeds to the site selected for the machine gun and the machine gun is unloaded and set up. The truck then moves to the searchlight position and picks up the searchlight trailer.

(5) After completing the movements outlined in (3) and (4) preceding, the trucks return to the battery motor pool or some other designated point to pick up personnel and equipment of another searchlight squad. If necessary, the searchlight truck may be used to lay telephone wire from the searchlight position to the battalion command post. The power plant truck, towing the searchlight trailer, should return to the designated point at once to make the trailer available for loading.

(6) All personnel present assist if heavy work is required to place the searchlight, control station, or power plant in position. (If the searchlight, power plant, or control station must be manhandled for some distance over difficult terrain, additional personnel from other searchlight squads should be provided.) Adjustments (leveling, removing transportation accessories, etc.) to the searchlight, control station, or power plant are performed by the appro-

priate operator after the truck has moved on. Each operator checks the operation of his instrument and connects the cables to the proper receptacles as soon as the cables are laid. The searchlight operator and the control station operator connect their telephones to the wire laid between their respective positions. The power plant operator starts the power plant and checks its performance but does not turn on the main switch until the light commander has checked to see that the proper connections have been made at searchlight and control station.

(7) As soon as the readiness of the searchlight set has been verified by the light commander, the power is turned on and the set is oriented and synchronized.

(8) When the searchlight set is ready for action, personnel trenches are dug, tents are pitched in the bivouac area, and straddle trenches are dug. As soon as possible, the searchlight, power plant, control station, and machine gun (in the order mentioned) are dug in (FM 5–15) and camouflaged (FM 5–20 and FM 5–20F). All interconnecting cables should be buried. (If the ground at the site is normally frozen during the winter months, the cables should be buried in ducts large enough to permit them to be easily withdrawn. When freezing of the ground is believed to be imminent, the cables should be withdrawn from the ducts and strung above ground on pegs high enough to support them above the level of normal snowfall.)

(9) Telephone lines from the searchlight positions to the battalion command post should be laid at once, normally by the battery communications section. The searchlight line to the battalion command post may be connected to the searchlight telephones either at the control station or the searchlight, whichever is more convenient. If the searchlight squad has only one telephone, it should be installed at the control station.

c. The instructions in subparagraph *b* assume a situation in which the searchlights must be emplaced

and ready for operation without delay. If some delay is permissible, the searchlight positions should be developed as much as possible (by the construction of searchlight towers; shelters for searchlight, control station, and power plant; personnel shelters; etc.) before occupying the position. Although searchlight equipment can be operated in the open, it should be sheltered if facilities are available and the tactical situation will permit.

49. PROTECTIVE MEASURES. The searchlight position should be organized for local defense, with defensive obstacles surrounding the entire area occupied by the searchlight and associated equipment. All elements should be dug in or revetted strongly enough to provide protection from small-arms fire and bomb and shell fragments (FM 5–15). If possible, the various elements of the system should be connected by covered routes, and defensive positions should be prepared which will permit the searchlight squad to cover the obstacles and deliver effective fire against enemy ground troops. (The weapons normally available to the squad consist of one .50 caliber AA machine gun, which is the primary weapon; one .30 caliber automatic rifle; and four .30 caliber rifles. The grenade launcher M7 or the rocket launcher M9A1 may be made available to the squad at the discretion of the headquarters battery commander.) The defense is coordinated with the local defenses of other nearby elements.

Note. For further information on local defense of searchlight positions and coordination of their defense with other elements of a 155-mm battalion, see FM 4–5. For a detailed discussion of defense against chemical attack, see FM 21–40. Methods of decontamination of materiel and infected ground areas are explained in TM 3–220.

50. WITHDRAWAL FROM POSITION. A suggested SOP for withdrawal from position is as follows:

a. The searchlight truck, towing the searchlight trailer, proceeds to the searchlight position. The

searchlight trailer is uncoupled, and the light commander, the searchlight operator, and the control station operator load the searchlight into the trailer. The truck proceeds to the power plant position and then returns to the searchlight, reeling in the power cable as it moves. The power plant operator assists in reeling in the cable. Back at the searchlight the searchlight telephone is loaded into the truck and the control station operator mounts the truck. The truck proceeds to the control station. The control station telephone is loaded into the truck. The control station is dismantled and loaded into the truck by the control station operator and the truck driver. The truck then returns to the searchlight, reeling in the control cable on the way. The loaded searchlight trailer is coupled to the truck. The light commander, the control station operator, and the searchlight operator mount the truck which then moves to its assigned place in the battery march column.

b. The power plant truck proceeds to the machine-gun position. The machine gun, water chest, and ammunition chests are loaded on the power plant truck. (The gun is mounted in firing position if air attack en route is considered likely.) The machine gunners mount the truck which proceeds to the power plant. The power plant is coupled to the truck, the power plant operator mounts the truck, and the truck proceeds to its place in the battery march column.

CHAPTER 7

CARE AND ADJUSTMENT OF MATERIEL

51. GENERAL. **a.** Searchlight equipment requires the same careful cleaning, lubrication, and adjustment as any other complicated machinery. The equipment is sturdy and should not require frequent adjustment if operated properly.

b. First and second echelon maintenance procedures for periodic cleaning, lubrication, and adjustment of searchlight equipment and power plants are listed in FM 44–75. Detailed maintenance procedures will be found in technical manuals describing specific types and models of equipment (app. I).

52. RESPONSIBILITY FOR MAINTENANCE. **a.** First echelon maintenance of searchlights and associated materiel is the responsibility of the operating personnel.

b. Second echelon maintenance of electromechanical systems associated directly with the searchlight system (with the exception of the power plant engine) is the responsibility of the searchlight electrician. Second echelon motor maintenance (including trucks, trailers, and the engine of the power plant) will be performed by mechanics assigned to the battery, battalion, or harbor defense.

c. Third, fourth, and fifth echelon maintenance of searchlight equipment (except trucks) will be performed by the Corps of Engineers. Third, fourth, and fifth echelon maintenance of trucks is a responsibility of the Ordnance Department.

53. MAINTENANCE PROCEDURES. For maintenance charts and procedures, see FM 44–75 and appropriate technical manuals (app. I).

CHAPTER 8

DESTRUCTION OF SEARCHLIGHT EQUIPMENT

54. GENERAL. Tactical situations may arise when lack of time and transportation will make it impossible to evacuate seacoast materiel. In such a situation, all materiel which cannot be evacuated must be destroyed to prevent its use by the enemy against our own and allied forces. Such destruction should be carried out only by order of the sector or higher command. The working principles to be followed are as follows:

a. The methods used must be adequate, uniform, and easily followed in the field.

b. If thorough destruction of all parts cannot be completed, the most important parts should be destroyed or removed. The same essential parts must be destroyed or removed on all like units to prevent the enemy from constructing one or more complete units from the damaged ones.

c. The searchlight battery or platoon commander should prepare plans for the destruction of materiel in the event of imminent capture. Such plans should make allowance for variations in available time, equipment, and personnel.

d. All searchlight personnel should be trained in methods of destruction of the materiel which they operate. However, the training should not involve the actual destruction of materiel.

e. Destruction should be accomplished in the following priority:

(1) Searchlights.
(2) Small arms.
(3) Tires.
(4) Vehicles.

(5) Communications equipment.
(6) Control stations.
(7) Power plants.
(8) Cables.

f. Destruction by any of the methods listed in the following paragraphs should be accomplished in the sequence indicated. Uniformity of destruction can be obtained in this way whether or not the method is carried to completion. Where an alternate method is indicated, it is not to be used unless the primary method is impracticable.

g. Certain of the methods outlined require special facilities, such as TNT and incendiary grenades, which may not be regular items of issue. The issue of such special facilities, and the conditions under which issued, are command decisions in each case and depend on the tactical situation.

55. SEARCHLIGHT. a. Use an ax or sledge to smash all external mechanical and electrical equipment, such as the lamp control mechanism, the arc switch assembly, the azimuth and elevation drive and control mechanisms, power meters and zero-reader indicators, resistors, and cable receptacles.

b. Break the drum door glass and throw a hand grenade into the drum. If grenades or other explosives are not available, shatter the glass in every segment of the drum door and use an ax, a sledge, or a concentrated burst of .50 caliber machine-gun fire to demolish internal elements of the drum. Make sure that the lamp head is destroyed and that the mirror is thoroughly distorted and perforated.

c. If incendiary grenades are available, ignite one under each tire. If they are not available, fire a concentrated burst with a .50 caliber machine gun into each tire and/or douse with gasoline and ignite.

d. Douse the remnants of the searchlight with gasoline and ignite.

56. SMALL ARMS. Methods for destruction of small arms are listed in appropriate field manuals.

57. TIRES. a. General. Whenever it appears likely that vehicles, searchlights, power plants, or other wheeled equipment may be captured by the enemy, it is essential to destroy the tires even though time does not permit destruction of the equipment of which the tires are a part. However, it will usually be possible to destroy tires at the same time as the equipment on which they are used.

b. Primary method. Ignite an incendiary grenade M14 under each tire. If TNT is being used to destroy other elements of the equipment of which the tires are a part, wait until the incendiary fires are well started before detonating the TNT.

c. Alternate method. Damage the tires with an ax, pick, or heavy machine-gun fire. (Deflate tires first, if possible.) Pour gasoline on the tires, dousing each one, and ignite.

58. VEHICLES. a. General. If explosive charges are prepared beforehand and carried in vehicles, keep caps and fuzes separated from the charges until they are to be used. If possible, detach and evacuate all machine guns mounted in the vehicles before destroying the vehicles.

b. Primary method. Remove and empty portable fire extinguishers. Puncture the fuel tanks. Place 2-pound charges of TNT on top of the clutch housing of trucks and as low as possible on the left side of the engine. Place a 2-pound TNT charge over the axle inside each wheel of trailers. Insert tetryl nonelectric caps with at least 5 feet of safety fuze in each charge. Ignite the fuzes and take cover.

c. Alternate method. Remove and empty the portable fire extinguishers. Puncture the fuel tanks. Smash all vital elements (such as distributor, carburetor, radiator, engine block, air and oil cleaners, generator, control levers, crankcase, and transmission) with a heavy ax, pick, or sledge. Pour gasoline, oil, or distillate on entire unit and ignite.

59. COMMUNICATIONS EQUIPMENT. a. Telephone equipment. Destroy handsets, headsets, chest sets, terminal strips, and battery cases by hammering. Destroy field wire by cutting and burning.

b. Radio equipment (if possessed by the unit). Destroy by smashing all units with an ax, pick, or sledge. Pour gasoline on the remnants and ignite.

60. CONTROL STATION. a. Remove the cover from the control unit and destroy all electrical equipment with an ax or sledge. Pour gasoline into the unit and ignite.

b. Remove the binoculars. If possible, evacuate them; otherwise, smash them with an ax or sledge.

61. POWER PLANT. For destruction of the tires and motor elements of the power plant, follow the methods outlined in paragraphs 57 and 58. Place 2-pound TNT charges in the generator unit and at the control panel and detonate with the cap and fuze combination prescribed for demolition of vehicles. If TNT is not available, smash the generator unit and the control panel with an ax or sledge. Douse entire unit with gasoline and ignite.

62. CABLES. Smash plugs. Heap cables in a pile, douse with gasoline, and ignite. If time permits, cut cables into short lengths before burning.

63. MISCELLANEOUS. Any equipment which has escaped destruction (including parts which may have been thrown clear by the bursting of demolition charges) should be piled together with some inflammable material such as wood or sawdust. Douse the pile with gasoline, oil, or distillate and ignite.

APPENDIX I

REFERENCES

1. FIELD AND TECHNICAL MANUALS.

FM 4–5	Tactics
FM 5–15	Field Fortifications
FM 5–20	Camouflage, Basic Principles
FM 5–20A	Camouflage of Individuals and Infantry Weapons
FM 5–20B	Camouflage of Vehicles
FM 5–20F	Camouflage of Antiaircraft Artillery
FM 5–20G	Camouflage of Rear Areas and Fixed Fortifications
FM 21–40	Defense Against Chemical Attack
FM 44–6	Employment of Antiaircraft Artillery Searchlights
FM 44–75	Service of the Antiaircraft Searchlight
TM 3–220	Decontamination
TM 4–210	Seacoast Artillery Weapons
TM 5–575	Searchlight, 60-inch, Model 1941 (General Electric)
TM 5–1721	Searchlight, 60-inch, Model 1942 and Control Station (Maintenance Manual, Sperry)
TM 5–1722	Searchlight, 60-inch, Model 1942 and Control Station (Parts Catalog, Sperry)
TM 5–1723	Searchlight, 60-inch, Model 1942 and Control Station (Operating Instructions Manual, Sperry)
TM 5–2721	Portable Power Plant for Searchlight, 60-inch, Model 1942 (Maintenance Manual, Sperry)
TM 5–2722	Portable Power Plant for Searchlight, 60-inch, Model 1942 (Parts Catalog, Sperry)

TM 5–2723	Portable Power Plant for Searchlight, 60-inch, Model 1942 (Operating Instructions Manual, Sperry)
TM 5–7040	Searchlight, 60-inch, Models 1941 and 1941A (General Electric)
TM 5–7044	Searchlight Trailer, Model 1131 Special [M1]
TM 5–7045	Searchlight, 60-inch, Model 1942 and Control Station (Operating Instructions Manual, General Electric)
TM 5–7046	Searchlight, 60-inch, Model 1942 and Control Station (Parts and Price Lists, General Electric)
TM 5–7047	Searchlight, 60-inch, Model 1942 and Control Station (Maintenance Manual, General Electric)
TM 5–7048	Portable Power Plant for Searchlight, 60-inch, Model 1942 (Parts and Price Lists, General Electric)
TM 5–7049	Portable Power Plant for Searchlight, 60-inch, Model 1942 (Operating Instructions Manual, General Electric)
TM 5–7051	Portable Power Plant for Searchlight, 60-inch, Model 1942 (Maintenance Manual, General Electric)
TM 5–7100	Sixty-inch Antiaircraft Searchlight Equipment, Model 1941 (Sperry)
TM 5–7138	Sixty-inch Antiaircraft Searchlight, Model 1940 (Sperry)
TM 5–7140	Sixty-inch Antiaircraft Searchlight, Model 1941A (Sperry) Searchlight, 60-inch, Model 1940 (General Electric)
TM 9–2810	Motor Vehicle Inspections and Preventive Maintenance Services

2. SUPPLY CATALOGS.

ASF Catalog ENG 7–S53	Searchlight, 60-inch, with Extended Hand Control, Sperry, M1942
ASF Catalog ENG 7–S55	Searchlight, 60-inch, General Electric Company, with Extended Hand Control, Models 1942 and 1942A

APPENDIX II

TECHNICAL DATA

1. COMPARISON OF GENERAL ELECTRIC AND SPERRY SEARCHLIGHTS MODEL 1942. a. In general, the basic operating principles of the General Electric and Sperry searchlights are the same. Within the general operating specifications prescribed by the Army, the two manufacturers have devised specific electrical and mechanical systems, each using the system best adapted to its own manufacturing facilities.

b. The following table compares the main features of the Sperry and General Electric searchlights M1942. (Words and abbreviations appearing in capital letters indicate exact labeling appearing on the equipment.)

	SPERRY M1942	GENERAL ELECTRIC M1942
Power plant:		
Motive power	Six-cylinder Hercules JXD gasoline engine.	Six-cylinder Hercules JXD gasoline engine.
Governor	Centrifugal (Pierce) single-speed setting.	Centrifugal (Pierce) single-speed setting.
Speed	1,100 r.p.m.	1,200 r.p.m.
Radiator position	At front end of power plant.	In center of power plant.
Radiator fan	D.C. electric-motor-driven.	Engine-belt-driven.
Generator	D.C. 16.2 kw.	D.C. 16 kw.

	Sperry M1942	General Electric M1942
Power plant—(contd.).		
Current (arc load)	162 amps.	160 amps.
Voltage (arc load)	100 volts	100 volts
Power cables	The single-conductor power cables, one positive and one negative, each 200 feet long, transmit d.c. power to the searchlight.	The single-conductor power cables, one positive and one negative, each 200 feet long, transmit d.c. power to the searchlight.
Arc circuit:		
Source of illumination	Direct current, flowing through the high-intensity carbons, creates an extremely hot arc and forms a globule of incandescent gas in the cratered tip of the positive carbon. The incandescent gas is the source of illumination.	Direct current, flowing through the high-intensity carbons, creates an extremely hot arc and forms a globule of incandescent gas in the cratered tip of the positive carbon. The incandescent gas is the source of illumination.
Positive carbon	22″ long x .633″ (16 mm) diameter.	22″ long x .633″ (16 mm) diameter.
Negative carbon	12″ long x .434″ (11 mm) diameter.	12″ long x .434″ (11 mm) diameter.
Burning time	1½ hours (approx.)	1½ hours (approx.).
Arc current	150 amps., d.c.	150 amps., d.c.
Arc voltage	78 volts, d.c.	78 volts, d.c.
Lamp control mechanism:		
Automatic control motive power.	*Feed motor*	*Mechanism motor.*
Positive carbon.		
Optical function	To maintain the crater of the positive carbon at the focal center of the mirror by means of the thermostat control.	To maintain the crater of the positive carbon at the focal center of the mirror by means of the thermostat control.

	Sperry M1942	General Electric M1942
Lamp control mechanism—(contd.).		
Operation.....	The positive carbon rotates continuously and feeds forward when the *ratchet* is held stationary by the *feed plunger* which is actuated by the *positive feed magnet.* This magnet is energized by the thermostat contacts or by the *cam-operated switch.*	The positive carbon rotates continuously and feeds forward when the *detent wheel* is held stationary by the *positive detent* which is actuated by the *positive feed magnet.* This magnet is energized by the thermostat contacts or by the *semiautomatic feed contacts.*
	The *cam-operated switch* is set for approximately one-half the rate of burning.	The *semiautomatic feed contacts* are set at MINIMUM.
Negative carbon.		
Electrical function....	To maintain the arc length (distance between the tips of the positive carbon and the negative carbon) at a constant value. Uses *voltage* control. Arc voltage varies directly as the arc length.	To maintain the arc length (distance between the tips of the positive carbon and the negative carbon) at a constant value. Uses *current* control. Arc current varies inversely as the arc length.
Operation.....	The *negative feed magnet coil* is connected in parallel with the arc. The electromagnetic force in the coil, which is proportional to the arc voltage, pulls the *armature* in opposition to the *arc length adjustment spring.* This action positions the *negative pawl guards,* which control the forward or backward movement of the negative carbon to maintain a constant arc voltage.	The *arc current regulator coil* is connected in series with the arc. The electromagnetic force in the coil, which is proportional to the arc current, pulls the *armature* in opposition to the *arc current adjustment spring.* This action positions the *current regulator contacts,* which in turn energize the *feed coil* or the *retract coil* of the *negative drive clutch.* The negative carbon is moved backward or forward by the action of this clutch, maintaining a constant arc current.

	Sperry M1942	General Electric M1942
Lamp control mechanism—(contd.).		
Semiautomatic control....	If the thermostat should fail, adjust the *cam-operated switch* by turning the *semi-automatic positive feed screw* 1¼ turns toward SEMI to increase positive feed. If this setting does not give correct rate, adjust to keep the positive carbon tip on the focal line of the *ground-glass finder*.	If the thermostat should fail, adjust the *positive semi-automatic feed contacts* by turning the *positive feed rate knob* clockwise toward its maximum feed position. If this setting does not give correct rate, adjust to keep the positive carbon tip on the focal line of the *ground-glass finder*.
Manual control.....	Used in the event of the failure of automatic control.	Used in the event of the failure of automatic control.
Positive carbon.....	Rotate the positive carbon by rotating the *positive rotation handwheel*. Feed the positive carbon forward and maintain the tip on the focal line of the *ground-glass finder* by pushing the *positive feed lever* to HAND position while the positive carbon is being rotated. *Care should be taken not to overfeed the positive carbon as it cannot be retracted.*	Rotate the positive carbon by pushing in and rotating the *positive drive crank*. Feed the positive carbon forward and maintain the tip on the focal line of the *ground-glass finder* by pushing in on *positive feed button* while the positive carbon is being rotated. *Care should be taken not to overfeed the positive carbon as it cannot be retracted.*
Negative carbon.....	Maintain the arc voltage at 78 volts, as read on the arc voltmeter, by pushing the *negative feed lever* to the HAND position and turning the *negative feed knob* one direction or the other to feed or retract the negative carbon.	Maintain the arc current at 150 amperes, as read on the arc ammeter, by pushing in and turning the *negative drive crank* in one direction or the other to feed or retract the negative carbon.
Dynamotor.....	Converts d.c. to a.c. for use by all a.c. elements of the searchlight equipment.	Converts d.c. to a.c. for use by all a.c. elements of the searchlight equipment.

	Sperry M1942	General Electric M1942
Distant electric control (DEC):		
Function.....	To provide a remote control of the searchlight in azimuth and elevation.	To provide a remote control of the searchlight in azimuth and elevation.
Operation.		
Automatic.....	The *DEC transfer switch* offers a choice between *automatic* and *manual* control. Automatic DEC is intended for direct control of the searchlight from a radar set, and is not normally used in seacoast artillery searchlight operation.	The *DEC transfer switch* offers a choice between *automatic* and *manual* control. Automatic DEC is intended for direct control of the searchlight from a radar set, and is not normally used in seacoast artillery searchlight operation.
Manual.....	Manual DEC provides remote control of the searchlight from the control station.	Manual DEC provides remote control of the searchlight from the control station.
DEC transmitters (control station).	When the DEC transfer switch is set to MANUAL, *azimuth* and *elevation synchro-transformers* (selsyns) located in the control unit are actuated by the control (observer's) handwheels. They are electrically connected through the control cable (300 feet long) to *azimuth* and *elevation synchro-transformers*. Two systems of DEC transmitters and receivers (33-speed and 1-speed) are provided with the equipment. However, only the 1-speed system is used in the manual DEC system.	When the DEC transfer switch is set to MANUAL, *azimuth* and *elevation transmitters* (selsyns) located in the control unit are actuated by the control (observer's) handwheels. They are electrically connected through the control cable (300 feet long) to *azimuth* and *elevation control transformers*. Two systems of DEC transmitters and receivers (33-speed and 1-speed) are provided with the equipment. However, only the 1-speed system is used in the manual DEC system.
DEC receivers (searchlight).		

	Sperry M1942	General Electric M1942
Distant electric control (DEC)-(contd.).		
Power drive system...	Displacement of the rotor of the DEC transmitter generates a voltage in the rotor of the DEC receiver. This error voltage is fed to the control grids of the vacuum tubes in the *azimuth* and *elevation amplifiers*. The output of the amplifiers excites the control fields of the *elevation* and *azimuth amplidyne generators*, which supply power to the drive motors which move the searchlight in azimuth and elevation. The rotors of the DEC receivers are geared to the searchlight so that movement of the drum moves them an amount equal to the movement of the transmitter rotors, restoring the system to balance and eliminating error voltage.	
Manual control:		
Function.....	To point the searchlight if the DEC system is inoperative.	To point the searchlight if the DEC system is inoperative.
Operation.....	Set the *elevation drive clutch handle* to HAND DRIVE. Place the *extended hand controller* in the socket on the left *trunnion arm* next to the *elevation drive housing* and engage it with the elevation gearing. The searchlight can be moved in elevation by turning the handwheel on the *extended hand controller*. It can be moved in azimuth by pushing on the *extended hand controller* in the direction in which it is desired to move the searchlight.	Put the *elevation clutch lever* and the *azimuth clutch lever* in the HAND position. Place the *extended hand controller* in the socket on the right *trunnion arm* (part of the *elevation control* box) and engage it with the elevation gearing. The searchlight can be moved in elevation by turning the handwheel on the *extended hand controller*. It can be moved in azimuth by pushing on the *extended hand controller* in the direction in which it is desired to move the searchlight.
Zero reader system.....	The zero reader system is designed for use in searchlight systems using a radar set for searchlight direction. It will not normally be used by seacoast artillery searchlight installations except as a check on the operation of the DEC system. Seacoast units using radar for searchlight direction should refer to technical manuals on searchlights and radar equipment for an explanation of the functioning of the zero reader system.	

APPENDIX III—DRILL TABLE

SERVICE OF THE 60-INCH SEACOAST ARTILLERY SEARCHLIGHT

Details	PREPARE FOR ACTION [1]	EXAMINE EQUIPMENT [2]	REST	STAND BY [4]	SPREAD	CONTRACT	IN	OUT
Light commander....	Supervises synchronizing and orienting of searchlight set. Tests functioning of DEC system. Checks communication system. If light has been removed from operating position as a camouflage measure, supervises unloading and emplacement of light.	When reports have been received from all members of the squad, reports to searchlight officer, "(Number of searchlight) in order."	Checks with other members of the squad on the functioning of elements of the searchlight set. Makes sure that one or both of the telephones is attended at all times.	When other elements have reported ready, directs searchlight operator to report azimuth read from searchlight azimuth scale. Checks to see that DEC moves searchlight to azimuth of target, if known. When squad is ready, reports, "(Number of searchlight) standing by."	.....	.....	Observes operation of searchlight and checks any evidence of improper functioning of any element. If extended hand control is being used, takes post 50 yards to the flank of the light and directs No. 1, by voice or signal, in search and illumination of targets.	Checks that squad is in "stand by" status.
No. 1, control station operator.	Assists light commander in synchronizing and orienting the searchlight and control station. Tests functioning of DEC by elevating and traversing the light. If the light has been removed from operating position as a camouflage measure, assists in unloading and emplacing light.	After checking performance of control station and DEC system, reports to light commander, "Control station in order." (Hand signal, "I am ready," may be used if circumstances permit.)	Remains near the control station.	Takes post at azimuth and elevation handwheels. On order or signal from the light commander, verifies that DEC TRANSFER switch is at MANUAL and turns handwheels as directed to synchronize light. Slews control unit (if necessary) to azimuth reported by No. 2, then turns light by DEC to azimuth of target (if known). If extended hand control is used, goes to searchlight to operate hand control.	.....	.....	When searchlight is illuminated, looks for a target in the beam. If none is visible, traverses 10° (5° either side of assigned azimuth). If target is not picked up, waits for orders from searchlight officer. When target is illuminated, follows it as necessary, keeping the target in the side of the beam next to the using organization.	Uses DEC to keep light pointed at approximate azimuth of target (if known). Stands by for further orders.
No. 2, searchlight operator.	Assists light commander in synchronizing and orienting searchlight and control station. Checks electrical system at the searchlight. Inserts fresh carbons in the lamp head and verifies that spare carbons are available. Verifies that extended hand controller is available and ready for use. Tests light mechanism by striking arc.[3] If light has been removed from operating position as a camouflage measure, assists in unloading and emplacing light.	After checking performance of searchlight circuits and mechanisms, reports to light commander, "Searchlight in order."	Turns off arc, if on. Closes spread-beam lenses, if open. Remains in vicinity of the light.	Prepares searchlight for operation. Before energizing DEC, checks the synchronization of searchlight and control station by observing the zero readers. After checking synchronization, reports, "Searchlight ready," to light commander. When directed by the light commander, reports, "(Number of searchlight) azimuth (reading of azimuth scale)." Opens spread-beam lenses, unless otherwise ordered.	Closes spread-beam lenses.	Opens spread-beam lenses.	When DEC has been checked, closes arc switch. Observes meters to make sure that proper voltage (78 volts) and proper current (150 amps.) are being supplied to arc. Recarbons arc at first break in operation after the positive carbon is half burned (after about 45 minutes of operation).	Opens arc switch. Stands by, ready to strike arc on command.
No. 3, power plant operator.	Checks gasoline, oil, and water supply, refilling if necessary. Starts motor and builds up voltage to required value. If light has been removed from operating position as a camouflage measure, assists in unloading and emplacing light.	After checking gasoline, oil, and water supply, and testing the performance of the power plant, reports, "Power plant in order."	Opens main power switch. Shuts down power plant and remains in the immediate vicinity.	Turns on power plant, adjusts voltages to no-load value, closes main power switch, and reports or signals to light commander, "Power plant ready."	.....	.....	Continues as at STAND BY, checking to see that voltage is at proper arc-load value and that amperage is correct.	Checks to see that output voltage is at proper control load value.

[1] This command alerts the squad at the beginning of a protracted period of operation or drill. Usually given once daily, shortly before nightfall.

[2] This command is usually given immediately following PREPARE FOR ACTION.

[3] If it is found that turning on the arc may reveal the searchlight position to the enemy, the front of the light should be covered by a tarpaulin before turning on the arc.

[4] This command is used to alert the squad when a target is known or believed to be approaching the area assigned to the light.

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